JPRS 74931

15 January 1980

West Europe Report

SCIENCE AND TECHNOLOGY

No. 10

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available from Bell & Howell, Old Mansfield Road, Wooster, Ohio 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. JPRS 74931	2.	3. Recipient's Accession No.

4. Title and Subtitle
WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY No. 10

5. Report Date
15 January 1980

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Joint Publications Research Service
1000 North Glebe Road
Arlington, Virginia 22201

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
As above

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This report contains information on national-level science policies, technology strategies, and research and development programs in West European science and technology in general and specifically in civil technology, with particular attention to transportation, energy, chemical manufacturing, industrial automation and technology transfer. The report will focus primarily on France and the Federal Republic of Germany, but will also cover important developments in Italy, the Netherlands, Sweden and other West European countries.

17. Document Analysis a. Descriptors

WEST EUROPE
Science and Technology
Civil Technology
Transportation
Chemical Manufacturing
Industrial Automation
Technology Transfer

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group 01, 07A, 10, 13B, 17

18. Availability Statement Unlimited Availability Sold by NTIS Springfield, Virginia 22161	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 55
	20. Security Class (This Page) UNCLASSIFIED	22. Price

(See ANSI-Z39.18)

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

JPRS 74931

15 January 1980

WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

No. 10

CONTENTS PAGE

DENMARK

Future of Wind Power in Denmark Discussed
(Claes Sturm; DAGENS NYHETER, 27 Nov 79) 1

FINLAND

Problems With Research, Research Training
(Fredrik Castren; HELSINGIN SANOMAT, 12 Nov 79) 4

FRANCE

New Undersea Cable-Layer Described
(Claude Amalric; L'USINE NOUVELLE, 18 Oct 79) 11

Deep-Sea Exploration Locates Metallic Nodules
(AFP SCIENCES, 11 Oct 79) 16

New Carburetor Attachment Achieves Fuel Economy
(Claude Amalric; L'USINE NOUVELLE, 18 Oct 79) 18

Utility of Nondestructive Quality Control Procedures
(Claude Amalric; L'USINE NOUVELLE, 18 Oct 79) 21

ITALY

Use of Heat Pumps in Factories To Conserve Energy
(D. Farina; FONTI DI ENERGIA ALTERNATIVE, Jan/Feb 79) 27

SWEDEN

Nature, Purposes of New Swedish Satellite Project
(SVENSKA DAGBLADET, 7 Nov 79) 45

Satellites for Earth Measurement
Anomaly in Magnetic Field,
by Hans Rehnvall

Sweden Develops Unmanned Submersible Vehicle
(SVERIGES FLOTTA, Nov 79) 49

FUTURE OF WIND POWER IN DENMARK DISCUSSED

Stockholm DAGENS NYHETER in Swedish 27 Nov 79 p 52

[Article by Claes Sturm]

[Text] Riso, 26 Nov--By 1995 Denmark will be getting 10-15 percent of its electrical power from the winds that sweep across the flat land, operating 1200 large and 30,000 small wind power plants.

About a hundred windmills are already in operation across the country.

Thus experiences have been positive and now a deliberate effort will be made both by private industry--12 different factories manufacture about 20 types of windmill--and by the state which has invested around 40 million kroner over a 3-year period in three coordinated projects.

None of this is much compared to the U.S. investment, for example, 300 million kroner a year for wind power research, but when calculated on a per capita basis the Danish investment is larger. Denmark is actually a world leader when it comes to small windmills and apparently small windmills have a great future ahead of them.

There are two reasons for this Danish superiority. The first is climate and geography. One of the three projects involves drawing a wind map and determining the places in Denmark where windmills can be placed with the least amount of disturbance.

The other reason is tradition. La Cour, a Dane, was the first to build an electric windmill.

Thirty Thousand

At the beginning of the 1930's there were around 30,000 windmills in Denmark, some performing mechanical work and some being used to charge batteries. During the war the F. L. Smith mills produced a large part of the nation's electricity. In 1957 a large--24 meters in diameter--Gedser mill was built which delivered in the period 1959-67 around 2 million kWh and is still being used for measurements in cooperation with the U.S. Department of Energy, among others.

Thus Denmark had a head start when the oil crisis of the 1970's came and therefore for the last few months five windmills have been turning at a regular test station and another two will be added soon.

As a first small victory for wind power we can mention that this project lies next to Denmark's atomic research station in Riso and that the humming blades clearly attract the greatest interest there. (Riso is now the center of all energy research in Denmark.)

Private Homes

The project includes testing small windmills by which the Danes mean mills up to 50 kilowatts, enough to supply a single-family home or a farm with electricity for most of the year.

The project leader is civil engineer Helge Petersen but as wing designer he also has a hand in the project dealing with larger windmills. Danish electric plants are interested in that because it involves 500-600 kilowatt mills intended to produce electricity for the general network.

Two of these have been set up in Nibe and are being tested there. They are about half as large as the Swedish wind power plants planned for Skane and Gotland.

"We know quite a lot about small windmills, we have learned how to control them, especially when it comes to safety," said Helge Petersen. "Increasing their size leads to many problems and we have no estimates as to what is optimum size."

One thing is clear, according to Helge Petersen. A small windmill is an excellent source of energy. In normal operation it will provide as much energy during the first year as it took to manufacture it. Everything from then on is extra.

Contest

In comparison solar collectors take many years before they produce the amount of energy it takes to manufacture them.

Up to now the production of small windmills has been based on craftsmanship and experience from the past. But Helge Petersen's project also includes a contest which has received 17 entries. An independent jury will judge the entries and two will be purchased and these prototypes will be tested at Riso in the same way as seven of the 20-odd types in existence are being tested there now for 3 to 6 months.

Other types will be tested in the locations where they already are placed and gradually the project will be able to approve various models, providing a basis for grants from the Ministry of Housing for the production of windmills.

Already grants are available to cover 30 percent of the costs and that is why there are so many. Those in existence cost between 70,000 and 250,000 kroner and would not pay for themselves without state aid.

The figures obtained will be presented in reports and provide a basis for new agreements between windmill owners and electric plants.

Agreement

There is already an agreement that excess power produced by windmills during periods with lots of wind is purchased for the general network but at a very low price, usually about what the fuel would cost to produce a corresponding amount of electricity. But on still days with no wind windmill owners must buy electricity from electric plants at normal and thus much higher prices.

"A new agreement will probably be much better because it will be possible to use windmills on a large scale," said Helge Petersen. "Ten or 15 percent of the electric power in Denmark can be produced by wind power without disturbing regular deliveries by power companies. According to predicted consumption in 1995 this would mean a need for 1200 big mills, distributed in groups of 10-20 at suitable locations, and 30,000 small windmills spread over the entire country.

"That sounds like a lot, 30,000, but we had that many in Denmark 50 years ago and all it means is that about every sixth farm or private home is provided with its own windmill, a tower 10-18 meters high with vanes up to 10-12 meters, judging by the most common designs.

"This development would save energy, it would provide manufacturing jobs, cut down on foreign trade through reduced oil or coal purchases and provide foreign currency instead since Denmark could export wind power if we utilize the technological head start we have," Helge Petersen said.

6578
CSO: 3102

FINLAND

PROBLEMS WITH RESEARCH, RESEARCH TRAINING

Helsinki HELSINGIN SANOMAT in Finnish 12 Nov 79 p 21

[Article by Fredrik Castren, general manager of Kymi company]

[Text] As a market area, Finland is small and its natural resources, except for forests, are scanty. Therefore, to compete internationally, production in this country must be based on other factors than natural resources or a large domestic demand. This is largely the case in all the Scandinavian countries. The only exceptions are Norway's oil and perhaps Sweden's limited ore deposits.

However, we do have one resource, which if skillfully nurtured and developed, can preserve and enhance our ability to compete internationally--our people's high level of know-how, learning and skill. I daresay that in the future, our economy will be based largely on our knowledge and skill.

This should be our starting point in dealing with education and research on all levels in this country. The level of know-how can be raised only by good education and purposeful research work. Institutions, government and industry in this country will become more dependent on the availability of sufficient research personnel of sufficiently high quality.

Technical research is only part of the broad field of research activity, but there is no justification for imposing an order of importance upon the various areas of research. Research important to our national economy is being performed in many areas.

It appears that future advances in technology will be based more and more on scientific research, particularly in industries based on advanced technology. But also in areas where the production process, the consumption of energy, raw materials, or the development of high product quality require the support of scientific research. Our opportunities lie in these areas, and in these areas we must develop our ability to compete.

Technological progress places requirements on the marketing of our products and know-how. It should be our goal to apply such resources to research and development that we could keep up with the powerful industrial nations, or at least stay close to them. If we fail, our future is clouded.

How have we done? Have we invested enough in research?

Not according to a study done by OECD. According to the study, in 1975 we invested less than one percent of our gross national product in research and development, while for instance, Sweden, even that investment is considered insufficient.

Statistics must be handled with care and those making decisions based on them must understand the context. If the context is not known, the decisions can lead astray, as we have observed many times. So it happened with a publication which analyzed business profitability in various countries, and not understanding the accounting background, listed Finnish businesses as being much better off than they actually were. This bad information was then quoted uncritically and without delving into the background of the statistics.

In light of the study, it is claimed that the amount of research in Finnish industry is low compared to our competitors. This sort of generalization is not valid.

First, we have a lot of processing industry in which the ratio of research to sales or national income is low all over the world. Second, we do not have any of the large, worldwide firms who spend great sums on remarkably broad and concentrated research programs and thereby raise the statistics for some countries. Third, we do not have any such government-financed projects as for instance some countries' substantial arms technology research. On the other hand, we have some good examples of sophisticated products and innovations which resulted from purposeful research, and by which we have been able to establish a notable position in the world market. Let us not get caught up in excessive modesty.

Nevertheless, there is good reason to state that, on the whole, we must vigorously increase industrial research and development with particular emphasis on more purposeful and goal-oriented activity in this important area.

In institutions of higher learning and in research centers both here and in Sweden, technical research has fallen behind because of insufficient funding. We are making a bad mistake. We must keep in mind our research objectives.

The research lag in the colleges is most regrettable because a shortage in basic research is quickly reflected in applied research and industrial research. In the interest of applied research, it is essential that sufficient basic research is done in this country. It is the basis of all research and also makes possible rapid utilization of research results obtained elsewhere.

What is needed is vigorous action and a purposeful outlook rather than the comparatively inconsistent support now being given to research. Economic research, also important to industry, is in the very same position as technical research.

What steps can we take to correct the situation? In this examination, we must begin with the grade schools. Not only research, but our whole skills level depends on the quality of education. Therefore I emphasize that already in grade school we should be paying more attention to the development of gifted students.

I seriously fear that in the name of deomcracy and equality as we are revising the school system we will drift into uniformity and a decline in quality. I hope my fears are groundless. Gifted people, regardless of their origins, must be offered the chance for self-development. This is the only way the gifted will get into the various areas where they can be used in the build-up of our research activity.

The Responsibility of the Colleges

Now back to research in the colleges and universities. Much is being said these days about meshing college research better with utilitarian research and thereby increasing proportionately the amount of applied research. I beg to differ. Research in the universities and colleges should form the foundation upon which other research can be built.

Therefore, appropriate basic research in the colleges should be increased over the quite insufficient amount now being done. It is often said that we do not have the resources for more extensive basic research. So we should concentrate more on practical applied research and make use of basic research done in other countries. But I do not think it is possible to adequately use the results of scientific research elsewhere unless we have adequate research personnel in the same fields who know how to utilize that research data.

Also, our own researchers can pick up that data through their international contacts and channels faster than it could be obtained from the literature. The results of research are usually published quite late, by which time part of the advantage has already been lost. Another important point is that we must not think that we have knowledge and experience to exchange.

Which leads me to the inescapable conclusion that the government must increase considerably its support of basic ersearch in the colleges. There must be an increase in research personnel, including research assistants, research work must be made more prestigious so that a career in research would be more attractive. In addition, research equipment is inadequate, and this problem too requires a considerable financial investment.

Of course, it is easy to burden down government with more and more responsibilities, without thinking of where the money will come from and who pays for it in the end. But we are dealing with something here that is so important to our national economy that we can give up many other expenses in order to increase research. Basic research cannot be considered separately; rather it must be integrated into instruction and development. Likewise, there should be more cooperation between the colleges, research institutions and industry. Those who have actively sought cooperation have had very positive experiences.

This way college research work would be given priorities and would fit in better with applied research being performed in the field. But I repeat that the colleges must concentrate on basic research above all else.

In regards to cooperation between the colleges and industry, it is important in some cases to require secrecy on research projects for competitive reasons, even though part of the research may be receiving public funds. Understandably, an industrial firm would be unwilling to invest in research, the results of which are immediately available for the benefit of their competitors.

The Importance of Cooperation

Earlier I touched upon international cooperation in the exchange of research data and experience and sharing the benefits of research. It is most unfortunate that the signficance of this kind of cooperation is poorly understood here.

Right now it is very difficult for researchers to get funding for the travel required to maintain international contacts. This applies to colleges and research institutions as well as individuals receiving research grants. For some reason, travel is considered unnecessary, even thought of as being for pleasure only. But the colleges, for instance, are in an excellent position to build for themselves good, solid contacts abroad which could become supremely important sources from which our industry could quickly obtain useful information.

When two researchers in the same field get together, the exchange of information is often remarkably free, and in this manner very important data moves from one researcher to another.

There must be better opportunities for increased international contact. Perhaps we should think of establishing a separate foundation to obtain such support, because the foundations now doing research are understandably hesitant to fund travel since there is not nearly enough money available even for research projects.

The independent research institutes, i.e. the National Technical Research Center, have increased their research capabilities and much of the work done there is commissioned. There is solid cooperation with the colleges. But here too we must ask: Should their general research work receive stronger support, thereby increasing the possibilites of obtaining broader and deeper knowledge?

It is good for a researcher, who is ever searching for something new, to break out of his old familiar "circles" occasionally and to follow his impulses in other surroundings. Therefore, it ought to be arranged so that researchers working in the colleges, the research centers and in industry could periodically work on projects in other organizations.

This way, someone working in a research institute would be challenged by participating in a project in industry, a college research could spend part of his time "in the field" and an industrial researcher could reciprocate with work on a college project.

We must remember that research--which is at its best innovation, the creation of something new--does not really fit into the framework of traditional work. We must think of research like this: in a way it must be disciplined, and in a way it must be free.

Research done by and for industry--primarily applied research and product development--has been done well in some firms and some areas, and is recognized internationally. As a result, some of our products have been rated highly internationally and have earned a foothold in the market, and we have a substantial sale of knowledge and skills.

Aside from a few favorable examples, industry on the whole must vigorously increase its investment in research. One way to do this, considering the scanty resources of individual firms, would be industry-wide, cooperatively supported research. Our forest industries have done this for some time with their research institute, and the metal industry has begun some cooperative research projects.

There are many areas of research which, if handled properly, could benefit the whole industy. Cooperation is the right and profitable way to do it.

One way to activate research and development in industry, which unfortunately has been used very little here, is to give a product development assignment and then to challenge industry with orders. A positive example of this was the challenge given to industry here to develop and produce larger transformers. As a result,the transformer industry in this country has done well, even in export.

Another example is the equipment requirements of the Helsinki subway. As the result of this challenge, we have a brand new capability for the manufacture of AC regulator equipment. This has opened up new export opportunities, and the industry is internationally recognized as being in the very vanguard, which has created new employement opportunities.

Meeting the Challenge

We do not have, as many of our competitors do, an arms or space research and development program creating new products, but even in civilian manufacture, there are research opportunities for industry which will stimulate product development and thereby prepare us for new conquests in export.

A challenge motivates us to perform well, and is therefore probably a more real and effective stimulant than various grants distributed inconsistently.

Currently, we are able to give altogether too little support to independent researchers and research teams working in institutions such as colleges, and elsewhere. If we observe what the various foundations are able to distribute annually as technical research grants, for instance, the total is surprisingly low. For example, the Foundation for Technical Advancement can make grants of only a few hundred thousand marks annually to a large group of applicants and must leave most of the very important research projects without funding.

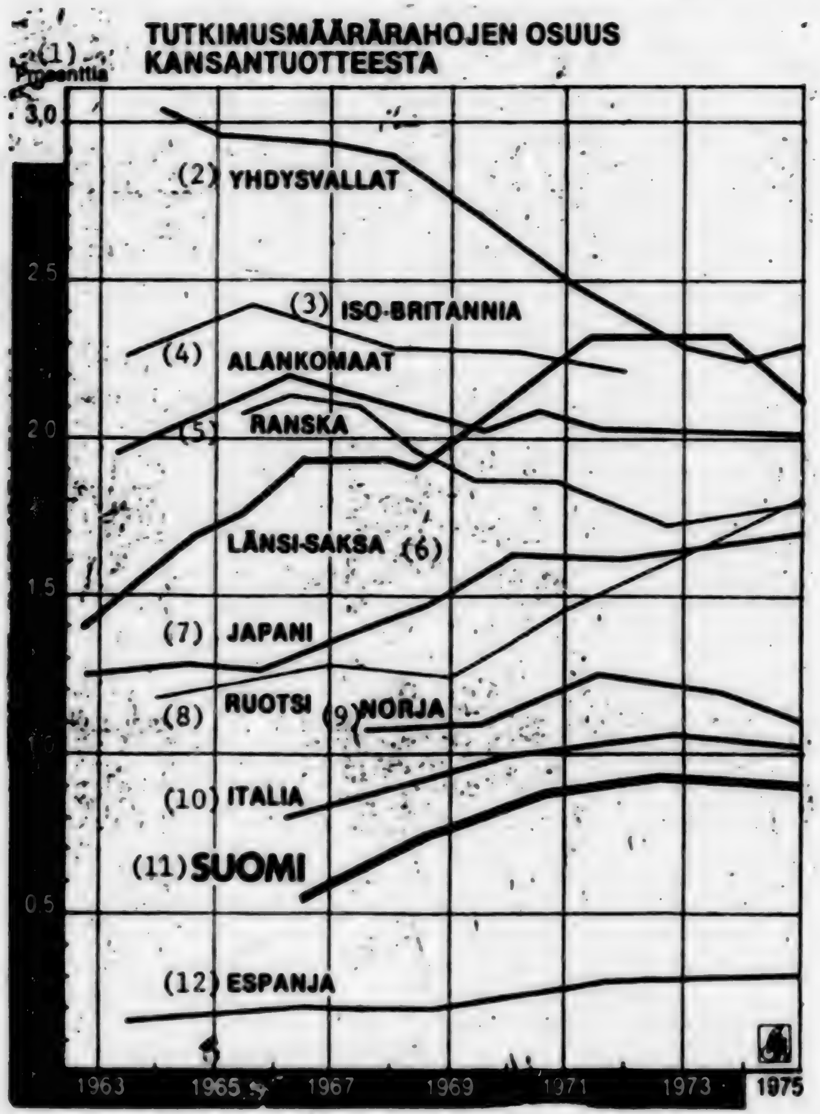
The total of all grants does not come anywhere near the annual research budget of a single middle-sized company. The amount ought to be at least 10 times as much so that it would have some significance as a stimulant to research activity. As it is, the money is sprinkled around, and we all know that its influence is minimal.

If it were nurtured properly, appreciated, followed carefully and its accomplishments exploited, the work done by independent researchers could have a significant influence on the national economy and on industry.

We cannot stress enough the importance of research in a country like ours, nor can we avoid the fact that we are not investing nearly enough in research at present. However, the government has clearly developed a more positive attitude towards research in the last few years and has become aware of its significance to the national economy.

I repeat, however, that the investment in research should be considerably larger and more goal-oriented, so that the results would fill the requirements we make of it for our future progress.

Research Grants As Percentage of GNP



Key:

(1) Percent	(7) Japan
(2) United States	(8) Sweden
(3) Great Britain	(9) Norway
(4) Netherlands	(10) Italy
(5) France	(11) Finland
(6) West Germany	(12) Spain

9551
CSO: 3102

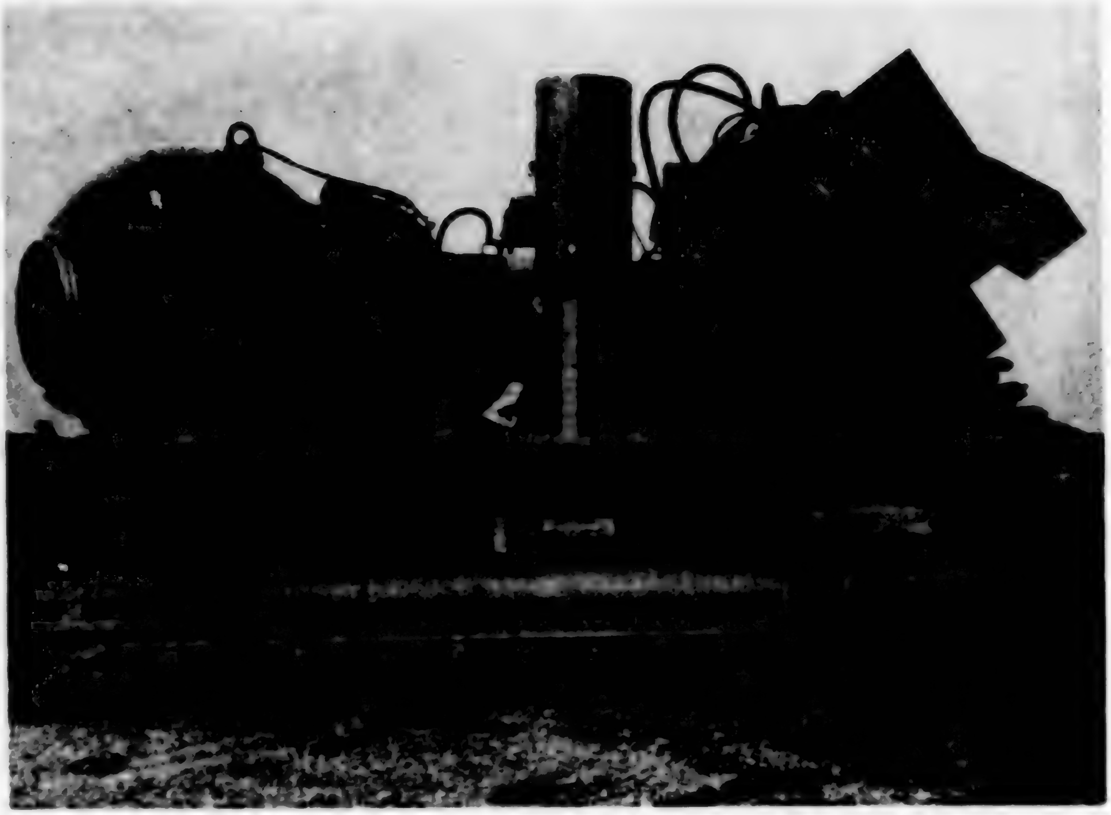
NEW UNDERSEA CABLE-LAYER DESCRIBED

Paris L'USINE NOUVELLE in French 18 Oct 79 pp 144-145

[Article by Claude Amalric: "Undersea Cablelaying: A Universal Tool"]

[Text] High Risk, But Profitable ...

To invest 10 million francs, practically putting it at the bottom of the sea, in the conviction that there will be a world market after the current contract has been completed: that takes a strong faith. At such a stage there is much need for certitude, for guarantees in deciding to produce an interring machine for the IFA 2 operation of the EdF; Chambon, the Marseille specialist in marine operations, had no such guarantees. There was but one assurance: the EdF operation would itself turn a profit ... assuming that it could be accomplished. And to find out whether the thing was possible there was only one way: to construct a prototype and experiment with it. And that is what they did: after the first feasibility studies in 1977 the prototype was assembled and submerged 1 year later. Related to the very imprecise knowledge of the sea bottom and its nature: the fields of enormous boulders were an unpleasant surprise. That was the risk being run. A fast redefinition of the dredge overcame this. From now on there will be no further technical obstacle to the planned electrical connection between France and England. And Chambon has at its disposal a cable-laying machine unique in the world which can also lay pipes and flexible hoses in offshore operations. A very big market practically created by the existence of this interring machine.



The undersea tractor follows the cable which has been placed on the sea bottom and while moving forward buries the cable by means of a special dredge which can either leave the trench open or close it.

Cable-Burying at the Bottom of the Channel To Establish Connection Between the High-Voltage Electric Power Network of England and France; From Now on This Will Be Possible Thanks to the "Subterranean" Machine of Chambon. An Open Door to the Offshore Market

During the 18 years in which it has been in service the submarine electrical connection between England and France has 10 times been damaged by fishing trawlers or by ship anchors. And this rate is accelerating: This year, for example, the repair services have twice been called upon. Every time it means 2-3 months of interruption to the connection. Not to speak of the cost which for this type of operation is very high.

It is for this reason that the decision to produce a second much more high powered connection has been held up in anticipation of the possibility of burying--the specialists say "ensouiller"--the eight cables provided beneath the undersea floor. Even if the 60-meter average depth were not an obstacle, the great variability of the Channel floor, swept by violent currents, represents an insurmountable difficulty for existing specialized equipment.

Confronted by this problem the two partners in the operation, each of whom will have to lay two pairs of cables, have independently decided to produce specialized machines.

On the French side the Marseille company, Chambon, has made a study of the machine under an EdF contract. The undersea tractor which has been produced constitutes a world "first" with respect to its subterranean potentialities. It can work at a depth of as much as 90 meters on a bottom ranging from sand to boulders having as much as 30 cm diameter.

Trials Crowned With Success

The principal originality of this equipment is the dredge which it carries at its rear. It is capable of digging a suitable trench 1.7 meters deep by 60 cm wide at a speed of from 60 to 150 meters per hour depending upon the terrain encountered. This trench is automatically reclosed or left open as desired. A clever feature: the bucket has a retractable bottom which facilitates ejection of the soil. The 13 teeth per bucket are another key point in the chain: there material and their shape are the result of long research. Moreover, a first prototype came to grief against this problem because there had been no provision for deposits of boulders.

Electric power comes from the surface through an umbilical cable. It drives a 150-kw motor coupled to a conventional central hydraulic unit. This vehicle is designed to pull up to 6 tons of load. Thanks to its rubberized caterpillars it can roll over the cable being buried without damaging it.

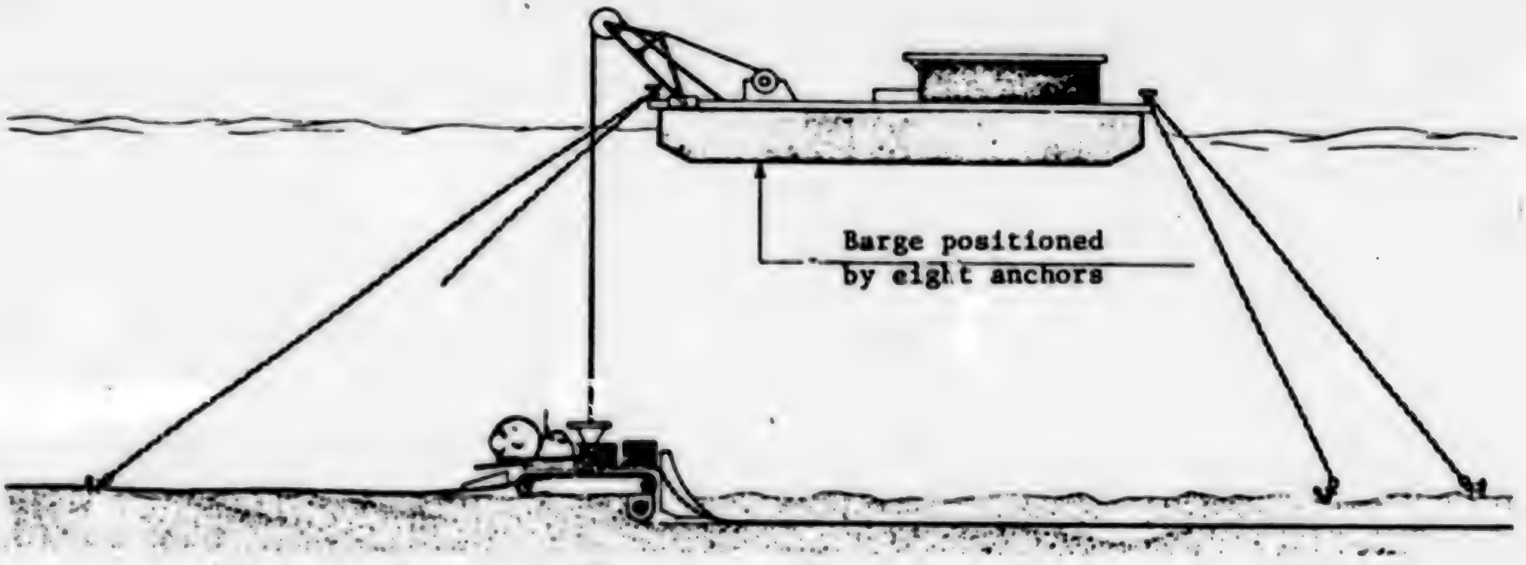
The cablelaying is done in two stages: the electric cables are placed at the sea bottom and then buried in pairs by the passage of the machine as it follows them as though following a guide wire. Thus in the connection being provided there will be two France-to-England tracks to be made.

Trials using a metallic cable have been carried out this summer with complete success over a range of 2 km selected as representative of the difficulties to be overcome.

The Connection Will Permit an Exchange of 2,000 MW

The driving of this vehicle is entrusted to two pilots for reasons of safety. The latter work in a broadly glassed-in sphere; but experience has shown that outside vision has been little used in driving, the pilots quickly learning to "feel" the position of the cable they are following.

The command module is at atmospheric pressure--a feature which augments comfort and diminishes decompression time after return to the barge on the surface. This degree of comfort makes it possible to limit reliefs to every 12 hours.



The cable having been positioned in advance by a cable ship is buried by the machine moving over the sea floor. A barge follows on the surface, stabilized by eight anchors, over the same route as that followed by the submarine vehicle.

The decision to establish the IFA 2 connection between Sangatte and Folkestone will be taken in 1980 since the feasibility of this operation has now been demonstrated. But first placement into service will require another 4 years. When it is fully operational this connection will make possible an exchange of 2,000 MW between the connected networks which is 12 times what is supplied by existing cables which, however, will continue to be in service.

8008
CSO: 3102

DEEP-SEA EXPLORATION LOCATES METALLIC NODULES

Paris AFP SCIENCES in French 11 Oct 79 p 15

[Unsigned article]

[Text] Paris--Abundant polymetallic nodules off the coast of Reunion. The "Marion Dufresne," scientific vessel chartered by the Administration of French Austral Territories, has revealed the presence of significant deposits of polymetallic nodules in the Indian Ocean and off the coast of Reunion. Shipped out from Durban (South Africa) for 1 month at the end of August the ship was charged with a geological and biological mission.

On arriving at the port of Pointe des Galets at Reunion on the 26th of last September Mr Leclaire, the mission's head and in charge of research at the CNRS and attached to the National Museum of Natural History, declared that his crew had demonstrated over 4,000-5,000 meters of ocean bottom in the Indian Ocean the presence of deposits of polymetallic nodules having a density of 100 kg per square meter whereas deposits known elsewhere had a density of 5-10 kg per square meter. The nodules which may be found in the Indian Ocean, explains Mr Leclaire, are like those of the Pacific composed mostly of iron and manganese 40 percent and of metals like nickel, copper and cobalt amounting to 1-2.5 percent in cumulative percentages. The zone which we have just explored, continued the scientist, presents the following special feature: the stock of nodules in the Indian Ocean containing nickel, copper and cobalt is inferior to that of the Pacific nodules but per square meter the nodules are more numerous. That is to say, a deposit which is not as rich but which is denser.

To explore the bottom of the Indian Ocean the "Marion Dufresne" is equipped with an oceanographic winch of which only two examples now exist in France. The crew has named this winch "Joseph." Thanks to this engine the scientists have been able to harvest pieces of ocean bottom cut into squares and weighing up to 1 ton. It is in this way that they have been able to measure the density of the nodules per square meter and per cubic meter. The nodule reserves of the north Pacific are rated at 65 million tons for the copper, 85 for the nickel, 16 for the cobalt and 1,700 for the manganese.

The minable reserves in the Indian Ocean have not yet been estimated. But 3.5 tons of nodules and of crust and 1 ton of basalt are en route to the National Museum of Natural History in Paris where Mr Leclaire and his crew will examine these minerals in the laboratory.

Mr Leclaire also declares with regard to the importance of this discovery: "Just in the Indian Ocean alone the English, the Americans, the Germans, the Japanese and probably the Russians are searching along with us."

As to the north Pacific reserves they are estimated at 1.7 billion tons of manganese, 65 million tons of copper, 85 million tons of nickel, 16 million tons of cobalt. The polymetallic nodules which look like blackish pebbles in the shape of potatoes have been mined since 1960.

8008
CSO: 3102

NEW CARBURETOR ATTACHMENT ACHIEVES FUEL ECONOMY

Paris L'USINE NOUVELLE in French 18 Oct 79 p 96

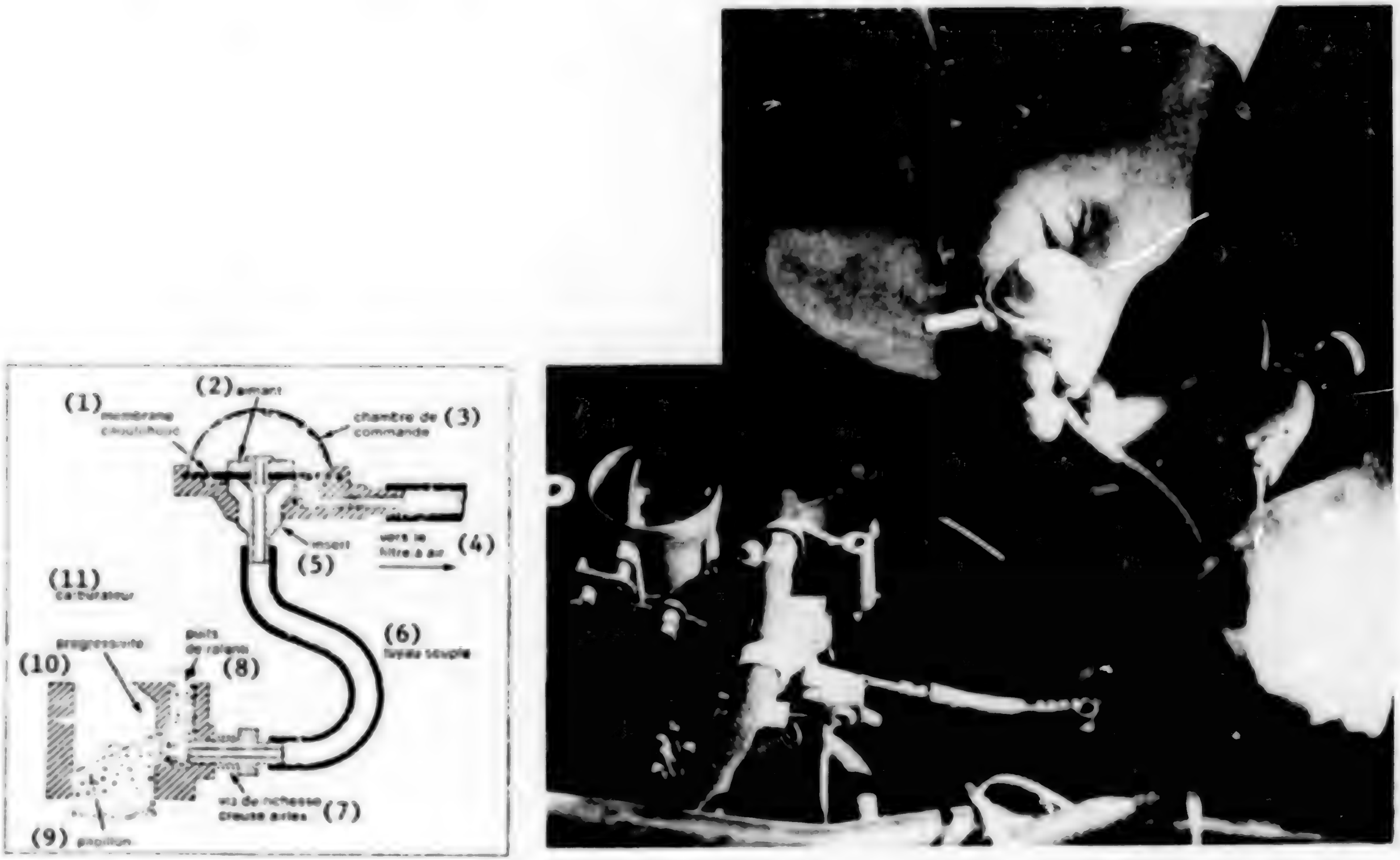
[Article by Claude Amalric: "The First Approved Gasoline Economizer"]

[Text] There Have Been About Thirty Claims to as Much as 25-Percent Economy in Automobile Fuel Consumption. But All of Them Have Succeeded Only in Getting 5 Percent. With the Exception of the Airlex as Proven by Documents of the Automobile, Motorcycle and Cycle Engineering Union (Utac)

A gasoline economizer for automobiles has just officially crossed the threshold of the 5-percent economy required by the Agency for Energy Economy as a preliminary to approval of such a device. Since pollutant emission is, moreover, sharply reduced by the Airlex device the latter has received the agency's approval and the assent of the minister of transport.

The results obtained vary from one vehicle model to another, thus requiring the manufacturer of the Airlex to request approval for each type; up to the present three French cars have been successfully tested for approval: the R 12, in which the economy measured has been from 5.2 to 7.1 percent depending upon the type of carburetor used; the R-5, in which consumption was reduced by 6.1 percent; the Peugeot 104, in which the reduction was by 6 percent. These figures taken from the verbal testimony of the Utac are therefore incontestable as long as one agrees that the European urban cycle assumed in the test procedure in which all these economies were observed is sufficiently representative of the driving conditions in the city. In addition the vehicles employed for the tests are used vehicles and the test series with and without the device to be tested have been numerous in order to take into account variations in atmospheric conditions. In the case of the 104, for example, the car had been driven 108,500 km before the 23 tests "without" and the 25 tests "with" the Airlex.

The principle of this economizer explains the absence of gain during the normalized cycle road tests in which the speed was kept at 90 and at 120 km/hr. In effect what is involved is a valve which connects the retarder shafts of the carburetor with the free air which gives rise to a marked depression when the carburetor butterfly is closed, the engine being braked.



A box containing the valve, a seal [durite] and a hollow screw: by these simple means 5-7 percent of gasoline saved.

Key:
1. Rubber membrane
2. Magnet
3. Command chamber
4. To air filter
5. Insert
6. Flexible hose
7. Airlex hollow screw richness control
8. Retarding shaft
9. Butterfly
10. Variable aperture [progressivite]
11. Carburetor

Since this depression draws in a lot of gasoline uselessly it is obviously desirable to suppress it. It is this which was accomplished by certain of the preceding devices, often very complex, such as the Bendix system on an electronic basis. Closer to the Airlex was the Sedem "EEE." But from the more simple to the more elaborate the investigators seem not to have recognized that complete suppression of the emission of gasoline during deceleration drives up the admission line which gives rise in the return phase to a very poor mixture resulting in misfires; as for the economy obtained it is counterbalanced by the spontaneously established humidification not to speak of the return pump which the driver actuates more vigorously in order to compensate for the poor quality of the mixture. All these defects are avoided by the Airlex very simply by permitting a portion of the depression to persist in the retarder shafts in which the emulsion is, on the other hand, improved by the internal aerodynamics of the air-feed screw. This perforated screw replaces the one commonly called "retarder screw." It is actually an air atomizer connected by a seal to the valve box which latter is ideally positioned in the air filter.

Commercialization will begin at the end of October with a model which can be adapted by adjustment to all vehicles, a circumstance which should dispense its manufacturer from getting approval for each model as has hitherto been necessary.

However, constant improvement in carburetors should render the Airlex inoperative on cars of the near future even if only as a result of the integration at the outset of a device performing the same function. But at the present time this accessory is not merely a gadget; and garage managers--like most individuals elsewhere--seem to need to amortize such an investment very quickly.

8008
CSO: 3102

FRANCE

UTILITY OF NONDESTRUCTIVE QUALITY CONTROL PROCEDURES

Paris L'USINE NOUVELLE in French 18 Oct 79 pp 135-137

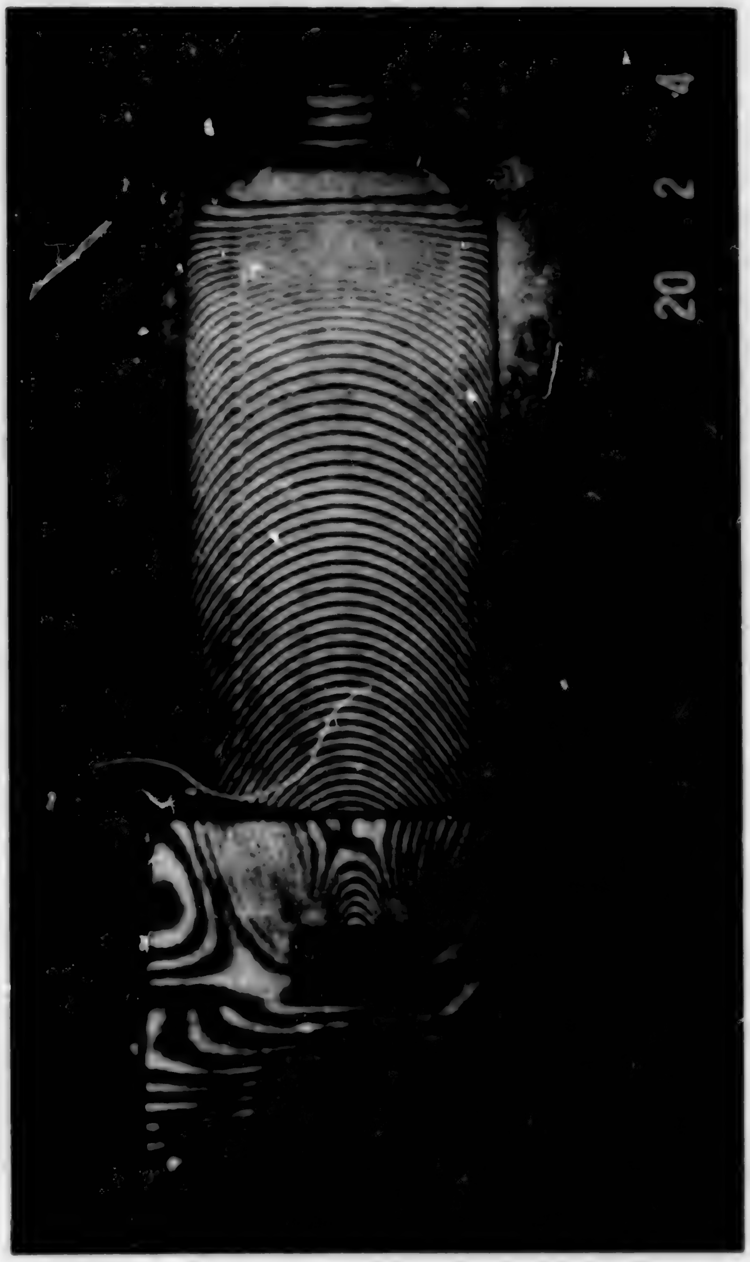
[Article by Claude Amalric]

[Text] Nondestructive methods of quality control (CND) are evolving quite rapidly. The fourth international colloquium on this subject held at Grenoble by CGR from 11 to 14 September was focused upon procedures which are under study or which are being improved. In fact the communications of this colloquium were rather centered on the applications of CND to the nuclear area, this sector of activity being the principal motivator of innovation in the techniques of quality control. But the information provided concerns all industries.

From sweating to neutrography, all the methods have one thing in common: the interpretation of their results is often a very delicate matter with the consequence that defective pieces are accepted when the quality control is perfunctory or on the contrary good products are rejected out of excessive caution, this excess arising just because the control is known to be imprecise. This was brought out in several talks.

That given by Andre Thomas of Framatome described an interesting experiment performed in order to establish the reproducibility of ultrasonic quality control in which the decision depends upon the amplitude of an echo compared with a reference signal. This speaker's staff wanted to know the part played by the skill of the operator and the part played by the material in determining the dispersion of the observed results. To this end 2,000 amplitude observations for real and artificial defects were collected; 60 apparatus-detector pairs were used by a single operator with transverse (45°) waves at 2 MHz.

For all the pairs and on all the artificial defects the reproducibility ranges from 5 to 6 decibels (6 decibels = 50 percent). Flat-based holes 4 mm in diameter in pure metal gave 4 to 5 decibels; notches opening into the opposite face gave 6 to 7 decibels. Real defects gave results varying from 4 to 5 decibels.



Interferometric holography possible thanks to the laser shows deformations on the order of 1 micron. The detection of weak spots is thus made easier during the design of an element.

Precision: Evolution Is Slow

At an interval of a few months a difference ranging from 2.5 to 3.5 decibels has been found in the preceding tests under the same operating conditions. In this case it is the detector which seems to be most at fault.

Therefore it is an imprecision of the first or second order which characterizes this method based upon the amplitude of an echo signal. "In the case of successive control examinations the divergence is 6 decibels more or less,..." the author concludes. Which well explains the difficulties of interpretation. There even comes a point at which in order to obtain agreement certain quality control examiners would not hesitate to change the gain of the oscilloscope in order to obtain a good pulse height on the screen.... "While visiting an American firm known for its careful work this is what I discovered, whereas I had originally expected rather to learn some lessons there," a participant confided to us who works with material for offshore drilling. Several other users have expressed their small confidence in most of the usual CND methods, "but we apply them because management--or the contract--requires them...."

However, these techniques are potentially very efficacious in locating defects. They are in process of acquiring the precision which at the moment they lack--even though this evolution is slow.

Some Improvements in Detail

Along this line, researchers at the University of Dortmund (FRG) have observed that the imprecision in the quality control of thin sheet metal arises from, among other things, the use of too large an ultrasonic pulse. Therefore they have produced what would appear to be a promising technique in which the size and spectral composition of the pulse (its shape) are controlled. In France a precision of 10 percent in the dimension of flat-based holes (the most difficult to detect according to Mr de Vadder of l'Ecam) has been obtained by using focused ultrasound.

Automated quality control is another approach for securing better definition of the defects found. At Cetim in Senlis, Pierre Moulin and Yves Pralus are attempting to adapt the parameters of ultrasonic quality control to the defects encountered; this is in contrast to the excessively tight sweep of existing devices which because of this characteristic allow certain defects to slip through which are badly oriented with respect to the beam. By adopting a large sweep permitting detection of the maximum of the echo this method detects all holes 3 mm in diameter and may be used to trace level curves of 6 decibels [or -6 decibels?]. Thus the dimensions of the defects are evaluated.

In quality control by Foucault currents the two procedures now being used accomplish a global check of the product (tubing) by using an annular coil surrounding it; this procedure leaves radial cracks in shadow or by using a small coil which shifts provides a control which is too localized. Confirming this, Pierre Clausin of Proengin has had the idea of combining the advantages of the two methods by studying the use of a detection system in which a rotating field explores the tubing under examination. Experimentation with copper tubes ranging from 10 to 20 mm in diameter and having a thickness of 2 mm has given the results expected.

The report of the Dutch investigator, Willem Korbee of the Apeldoorn Metaal Institute, is more or less the same. Here it is the coil which rotates around the tube but at 30,000 rpm thus providing an inspection speed of 5 meters per second. "However," comments the author, "at this speed the eye distinguishes nothing. That is the reason why we are right now introducing a system of automated analysis."

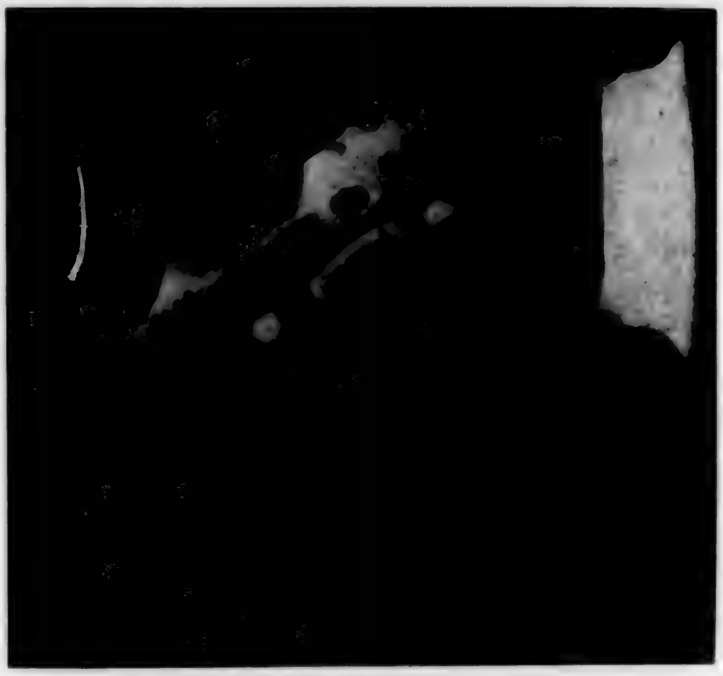
Another constant feature of work in progress aimed at making the methods of CND more effective is recourse to automatic information processing. This is almost universal in all these domains. In radiography, for example, while certain people consider that there is little aid to be obtained from a computer in examining a plate, "where it is above all experience which is important," it is a fact that the tomodensitometer which when used medically is known as a scanner turns out to be an excellent CND device. Bernard Gagnage (Snias Marignane) and Andre Cagnasso (CNRS Marseille) have proven this by using it to examine helicopter rotor parts with results that are very conclusive--at least with materials having a density less than twice that of water, since that is the situation in the case of the human body for which the apparatus was designed. The composite materials used in aeronautics (resin, wood, plexiglas) are in this class. For other materials, "a device designed for industry could range up to a density of 4, or even up to that of conventional metals." A cut of the piece examined has, to be sure, shown the presence of all the detected defects ... but more besides.

X-ray diffractometry has a bad reputation: its very high imprecision seems to result in part from too premature a generalization of a theoretical relationship between two measured angles, "rarely verified in practice," according to Louis Castex of the Insa of Toulouse. This has given rise to his idea of putting the most recent theoretical discoveries into a computer. He is now in process of developing it but interest in his work derives from the fact that it should contribute to making X-ray diffractometry "very soon one of the rare CND techniques which can be used reliably and rapidly in the shop and in the laboratory." It could allow, for example, quality control of a metal bridge.

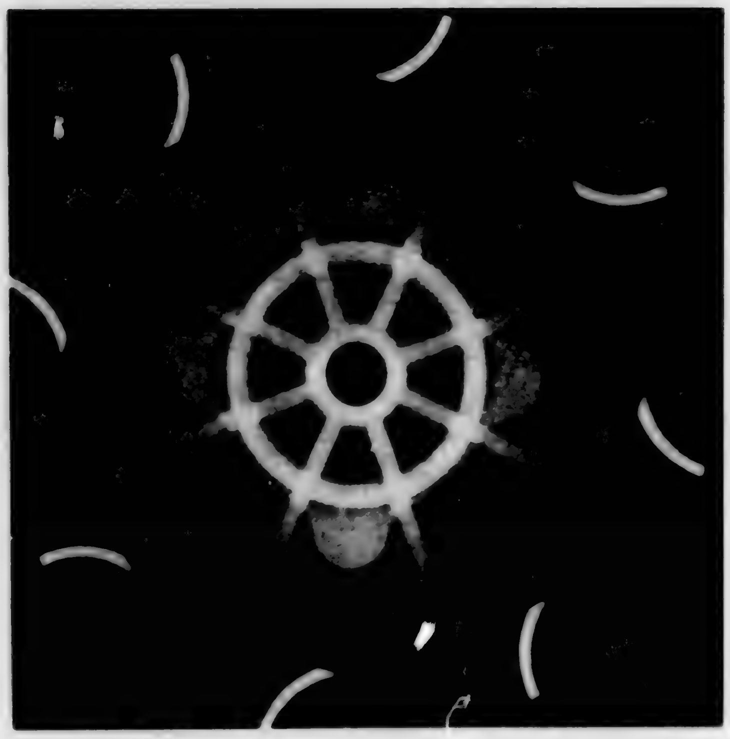
One of the richest techniques of the future is acoustic emission. Like X-ray diffractometry--and holography--it has suffered from its analytic complexity. Let us recall that it consists in listening to sounds emitted by the material ... whenever there is a fracture; its purpose is surveillance of fissures, especially in aeronautics and in nuclear power plants. Recent experience in the latter two domains provides a good indication of the value of acoustic emission because before a rupture the material "cries out" for a long time; but each emission confirms the presence of a degradation. A systematic recording of these sounds (at frequencies ranging up to several megahertz) and observation of the variation in their recurrence provides information concerning what is about to happen; experience and the computer will certainly make it possible some day to add "when it will happen." For the present it is already difficult to determine "where" the event will take place despite the distribution of a network of collectors for gathering observations. Acoustic emission is the seismology of industry: today this analogy is a fitting one with regard to the state of the art and the reliability of its predictions.

Applications Still Far in the Future

James Roget of Cetim has commented on a recording of the acoustic irradiation of a steel tank pressurized to the point of bursting. "Its acoustic behavior has been correlated permanently with the damage produced. The beginning of plastic flow in the steel gave rise to a very intense pseudocontinuous emission. Then the latter diminished only to become strong again just before rupture."



Transparent examination reveals many defects which would otherwise remain hidden. This is the advantage of radiography. Equipment reduction and improvement in the supporting framework are popularizing this method which up to now has been reserved for very costly products. (Kodak document)



Acoustic emission is a quality control method which more than any others depends for its efficaciousness upon the computer. This device can process data produced by a network of 16 collectors on the basis of which it locates the sources of the observations. The recording, which is indispensable in acoustic emission technique, contains the history of the damage under surveillance. (EMI document)

There were other reports relating to sound waves in concrete, acoustic irradiation of concrete under tension, the detection of fissures by measuring electrical resistance, ultrasonic quality control of bolted assemblies, etc.

With regard to more recent methods like holography these were likewise the subject of discussion. But their application appears to be still far off.

8008
CSO: 3102

USE OF HEAT PUMPS IN FACTORIES TO CONSERVE ENERGY

Rome FONTI DI ENERGIA ALTERNATIVE in Italian No 1, Jan/Feb 79 pp 48-58

[Article by D. Farina, chief of Research and Development Department of DELCHI SpA, Villasanta (Milano): "The Heat Pump: a Means for Reducing Energy Consumption and for Recovery of Heat in Industrial Installations"]

[Text] Introduction

World energy demand is certainly destined in any case to increase both in the industrially developed countries and in the developing ones.

Within the next 30 years, total demand will double over today's level, and therefore the gap between demand and availability of energy resources of traditional type (petroleum products) is destined to grow and thus necessitate an attempt to utilize alternative energies.

One must therefore conclude that in the coming years, there will be a strong upsurge in policies for conservation and recovery of energy. Such savings policies will be directed in particular toward the field of production of electrical energy, since this is the most widespread and most heavily used form of energy.

Among the systems capable of producing electrical energy and at the same time recovering heat in industrial installations is the heat pump, connected with a well-known principle of applied physics.

The Heat-Pump System

The simplest way to produce heat by means of electrical energy is to make the current go into a resistance, in which the electrical potential is dissipated, generating heat through a well-known physical effect; by this system it is normally possible to obtain 1 kWh_t (= 860 calories) for every kWh_e of electrical energy consumed.

As we shall see, the heat pump makes it possible to produce heat (by means of elctricity) with an efficiency 2 to 5 times higher than that of an electrical resistance. This great advantage is due to the fact that in the "heat pump" system, little electricity is actually consumed to generate heat at a low temperature level, and this heat is then raised to a high temperature level for convenient later use.

The heat pump is based on the refrigeration cycle--that is, on the simple physical process that makes it possible to cool foods, for example, in our refrigerator at home. In this case, the heat is contained in the foods and is transferred from them to a refrigerating fluid that circulates in the electrical appliance. For this fluid to be cooled in turn, it is generally passed through an external coil, and in this way throws away the heat it contains. In the heat-pump systems, though, it is precisely this heat that is utilized, making for an obvious energy saving.

The conventional refrigerating cycle (Figure 1) makes use, as is known, of the property possessed by fluids in passing from the liquid state to the gaseous state (evaporation)--that is, the necessity of receiving or absorbing heat in order to become aeriform, as well as the necessity of being cooled (that is, of giving up heat) when they go back from the gaseous to the liquid state (condensation).

A compressor (which may be of the reciprocating, centrifugal or screw type) sucks refrigerating gas (usually a halogenated compound commonly called freon) at low pressure and sends it compressed and at high temperature into a heat exchanger (condenser) where, heating water or air, the gas cools and condenses into a liquid at high pressure. This liquid, passing through a choke valve, expands down to the low pressure created by the compressor in a heat exchanger (evaporator) and, evaporating, takes from the air or water the heat necessary for its evaporation, cooling them.

Now if it is desired to cool something, the heat generated in the evaporator is used (and we have the refrigerator); but if it is desired to heat something, we use the heat generated in the condenser (and we have the heat pump).

The transport of this heat consumes energy--usually electrical--to run the compressor.

The total heat which we find at the condenser is that taken from the evaporator plus the enrgy supplied to the compressor, which also is ultimately transformed into heat.

Heat pumps can be classified according to the two sources between which they function as:

1. air/air
2. air/water
3. water/air
4. water/water
5. soil/water
6. soil/air

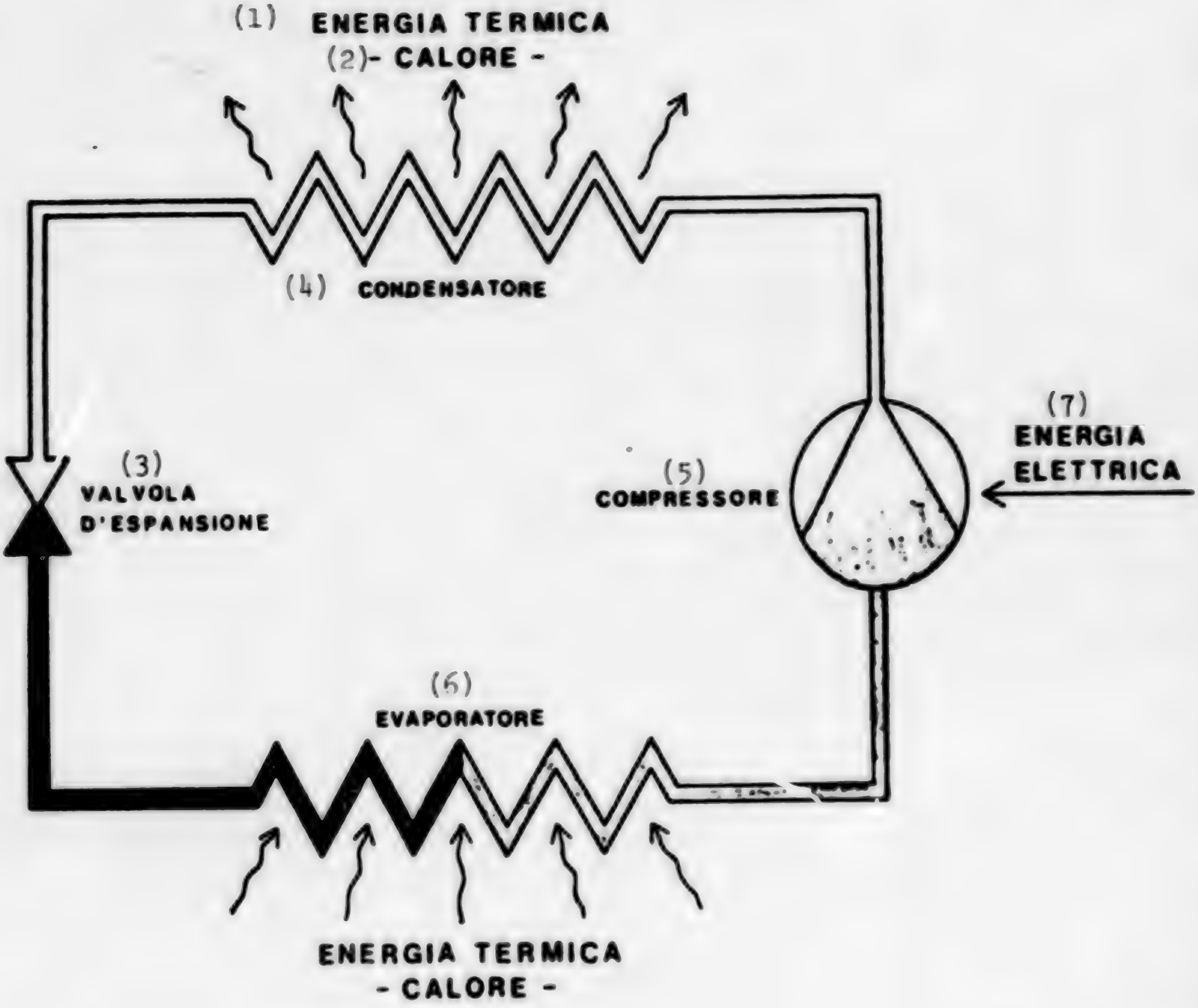


Figure 1. Conventional refrigeration cycle

Key:

1.	Thermal energy	5.	Compressor
2.	Heat	6.	Evaporator
3.	Expansion valve	7.	Electrical energy
4.	Condenser		

Efficiency of the Heat Pump

As a matter of fact, then, the system furnishes considerable thermal power (kW_t) with low consumption of electrical power (kW_e).

The characteristic parameter of the heat pump is called coefficient of performance (COP), and indicates its efficiency. Obviously, the COP is given as the ratio between the heat obtained from the machine (thermal power) and the total electrical energy furnished to the machine itself for its functioning (electrical power absorbed):

$$\text{COP} = \frac{\text{thermal power obtained (kW)}}{\text{electrical power absorbed (kW)}} \; *$$

The values of the coefficient of performance of a heat-pump type of thermal system can also differ quite a bit, inasmuch as they depend on the nature and the temperature levels of the two sources (cold source and hot source) between which the machine functions cyclically. In fact, the bigger the difference between the temperatures of the two sources, the more fatiguing it is for the heat pump--that is, the more energy it absorbs in transporting the heat from one temperature level to another.

The values of the COP range from 2 to 5. These numerical values are not mechanical duties (they are in fact higher than unity); rather, they indicate the efficiencies of heat-pump systems--that is, they indicate how much heat at lower temperature can be transferred to higher temperature for each unit of electrical power furnished to the machine.

Efficiencies of Heating Systems

The advantageous aspects of the heat-pump system are obvious if one considers the efficiencies that can be achieved--in a given heat-production (heating) installation--by direct use of a petroleum fuel (gas oil, naphtha) or of electrical energy, and the latter in both cases: electrical resistances or heat-pump system (Figure 2). With a petroleum fuel, with the transport, losses, and thermal-installation output taken into account, final efficiencies of 65 percent are achieved; with use of electrical resistances (given the low output of electrical generators), overall efficiency drops to 30 percent; finally, with the heat pump, we can have an efficiency of 80 percent.

Applications of the System

In the area of applications, the most highly developed uses of heat-pump systems are:

(1) air-conditioning and heating of buildings (houses and apartments);

(2) recovery of heat from the processes in industrial installations; and also the same heat recovery in large conditioning installations.

We give several illustrative examples of these applications.

---

* In the total power absorbed by the machine, the energy absorbed by any auxiliary devices, such as fans, pumps, controls, etc, must be computed also.

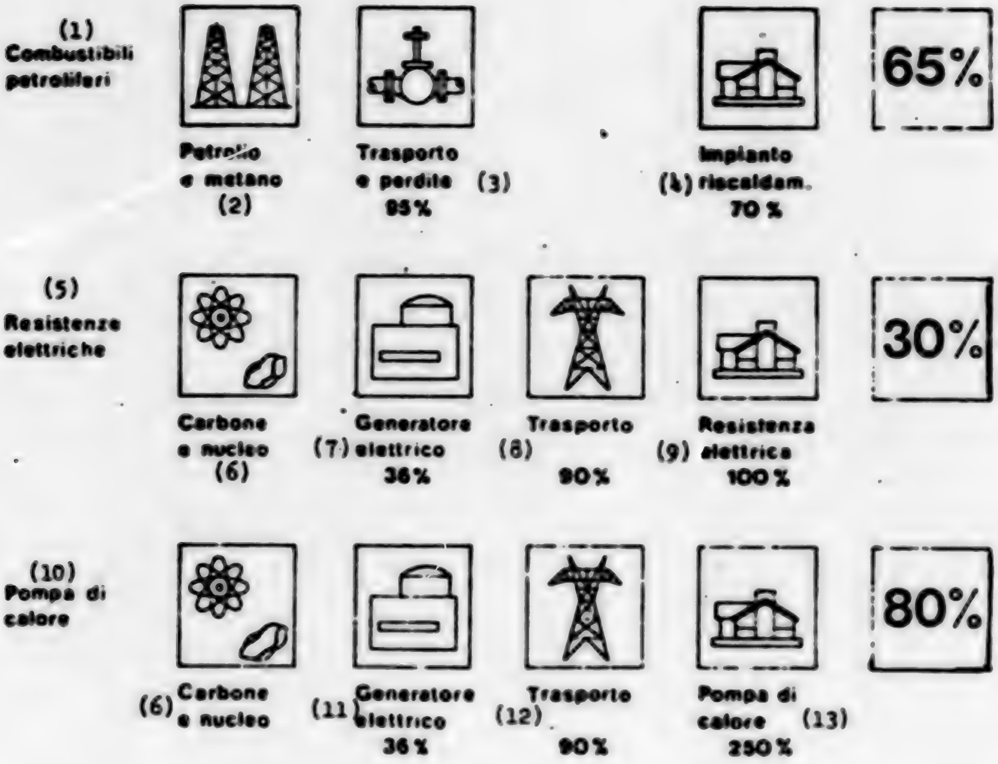

(1) Combustibili petroliferi
Petrolio e metano (2)
Trasporto e perdite (3) 95%
(4) Impianto riscaldam. 70 %
65%
(5) Resistenze elettriche
Carbone e nucleo (6)
(7) Generatore elettrico 36%
(8) Trasporto 90%
(9) Resistenza elettrica 100 %
30%
(10) Pompa di calore
(6) Carbone e nucleo
(11) Generatore elettrico 36 %
(12) Trasporto 90%
Pompa di calore (13) 250 %
80%

Figure 2. Efficiencies of some heating systems in relation to the primary sources of energy

Key:

1. Petroleum fuels
2. Oil and methane
3. Transport and losses 95%
4. Heating installation 95%
5. Electrical resistances
6. Coal and nuclear power
7. Electrical generator 36%
8. Transport 90%
9. Electrical resistance 100%
10. Heat pump
11. Electrical generator 36%
12. Transport 90%
13. Heat pump 250%

---

1. Air-Conditioning and Heating

For residential air-conditioning and heating of houses and apartments, installation of low-power heat-pump plants, generally from 5 to 60 kW_t (that is, from 4,000 to 50,000 kcal/hour) is becoming more widespread.

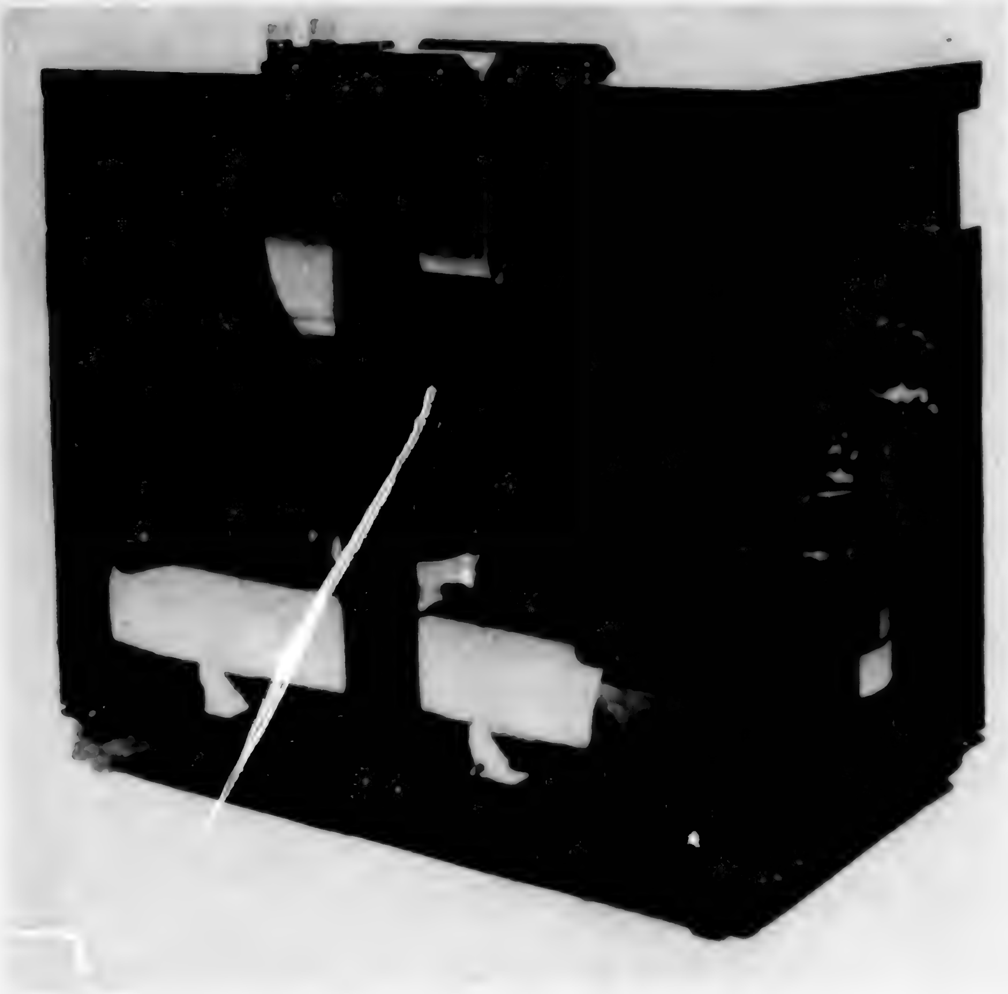


Figure 3. The heat pump

In these cases, the cold source is the outside air, which is cooled, and the heat thus obtained is transferred to the air (or the water) for the inside heating system.

During the summer, by reversing the system's cycle of functioning, cooling of the rooms of the same buildings can be provided for. In this way, a conditioning system can function year-round.

These types of installation are very widespread in the United States, where in the year 1977 alone, 400,000 units were sold.

The heat pumps for room air-conditioning (thus, units of low thermal power: from 8,000 to 21,000 kcal/hour) are of very small dimensions (Figure 3), and they are available both in a one-part version and in two separate sections, connectable--one consisting of the compressor and the condenser (placed outside the building) and the other consisting of the evaporator (inside).

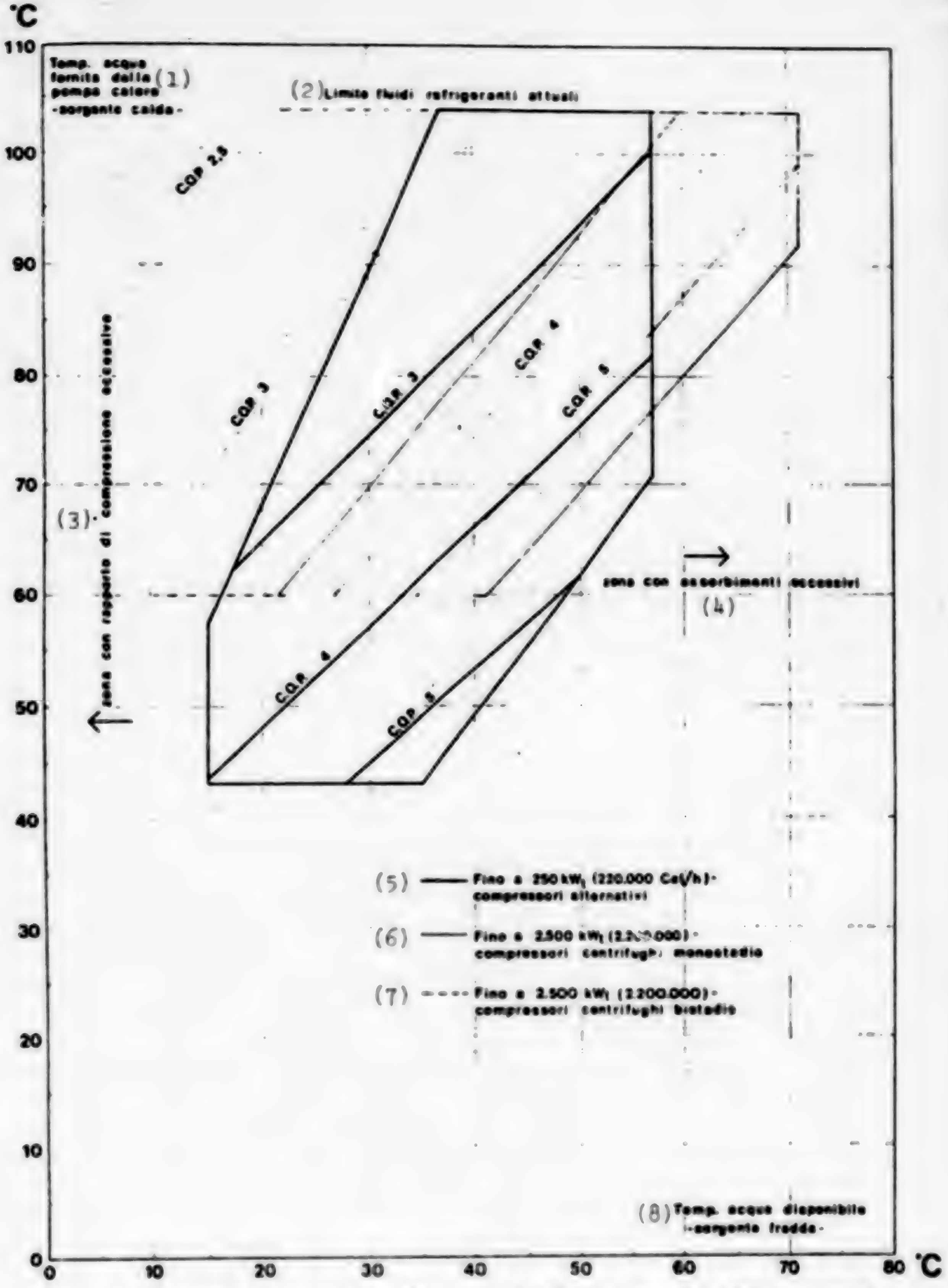


Figure 4. Zones of use of the "water-water" heat pum in heat-recovery installations [Key on following page]

[Key for Figure 4]:

1. Water temperature furnished by heat pump - hot source
2. Limit of present refrigerating fluids
3. Zone with excess compression ratio
4. Zone with excess absorption
5. Up to 250 kW_t (220,000 cal/hour) - reciprocating compressors
6. Up to 2,500 kW_t (2,200,000) - single-stage centrifugal compressors
7. Up to 2,500 kW_t (2,200,000) - two-stage centrifugal compressors
8. Water temperature available - cold source

If we consider our country's mild weather conditions, thermal climatizing plants of the heat-pump type are finding an excellent position for obtaining high efficiencies and considerable energy savings.

From a study conducted on the basis of the average winter-season temperatures of 19 Italian cities, it emerges that--with equal heating management and at current prices (May 1978) for gas oil and electrical energy--management savings of 10 percent to 30 percent can be achieved, with coefficients of performance between 2.5 and 3. A heat-pump installation usually represents a considerable initial cost, especially if considered an installation for winter heating only. This disadvantage disappears completely in the case of a conditioning installation functioning year-round.

2. Recovery of Heat in Industrial Installations

Within a short time, heat-pump systems will be very important for recovery of large quantities of heat resulting from work processes or from heating in industrial plants--heat that would otherwise be lost because it is normally ejected into watercourses through drains or is released into the atmosphere, in cooling towers, for example.

Therefore, in the designing of a heat-pump system, it is necessary to determine in each firm, case by case, what the low temperature-level heat sources are that cannot be exploited in the firm's own processes, and then to design a heat-pump system capable of raising these quantities of heat to higher temperature levels, to be usable again.

Low temperature-level heat sources in industry can be (for example):

--the cooling waters for processes;
--the cooling waters for refrigeration plants;
--the cooling waters for rubber and plastic-material extrusion and injection machinery;
--the waters used in textile-industry processes;
--the water used to cool air compressors;
--the water used to cool thermal power-plant condensers, etc;
--the waters heated by solar collectors.

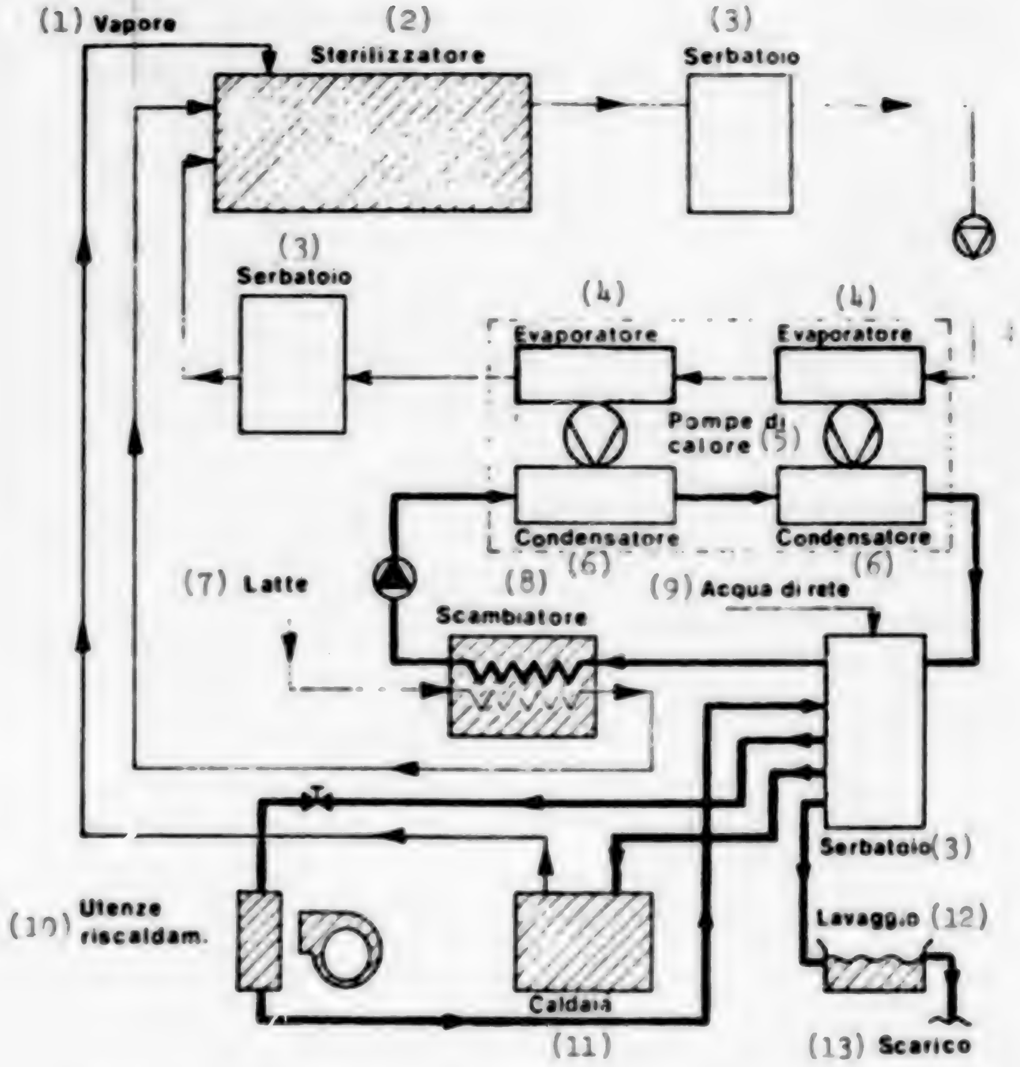


Figure 5. Recovery of heat in a milk sterilization plant

Key:

1. Steam
2. Sterilizer
3. Tank
4. Evaporator
5. Heat pumps
6. Condenser
7. Milk
8. Exchanger
9. System water
10. Heating uses
11. Boiler
12. Washing
13. Discharge

Naturally, the water from any available water body (river, lake, sea, storage tanks) can also function as a cold source.

Therefore, if one has waters available with temperatures between 15° and 50° C (and averaging between 20° and 30° C), one can obtain hot water with temperatures between 50° and 100° C, with coefficients of performance from 3 to 6. Strictly by way of example, the graph in Figure 4 shows the areas of use of these types of heat pump--that is, the water-temperature levels obtainable in function of the temperature levels of the waters available as cold sources.

The graph also shows the coefficients of performance (efficiencies) with which heat recovery is achieved. The solid line indicates the zone of the small and medium-size machines, using piston-type compressors, with power up to 2,500 kW_t (about 220,000 kcal/hour).

The dash-dot lines indicate the zone of the centrifugal machines, medium and large, with powers up to 2,500 kW_t (2,200,000 kcal/hour); finally, the broken lines indicate the zone of the two-stage centrifugal machines.

As we have said, the temperature level of the industrial waters (or fluids) available is raised by means of compression. In the present state of the art, since the refrigerant fluids available are not suitable for working at high temperatures, and in view of the technological limitations of compressors, the maximum temperature levels that can be achieved are around 105° C. Foreseeable technological developments, especially in refrigerants, will make it possible to reach temperatures of 200° C, but it will be difficult to go beyond that maximum limit.

The hot water thus obtained can be used in a great many ways. We point out some of them:

1. space heating
2. drying
3. cleaning and surface treatment of metals
4. distillation processes
5. food industries
6. degreasing and painting-preparation installations.

Last but not least, it should not be forgotten that heat recovery by means heat pumps is an ecologically clean system; indeed, there are neither naphtha fumes nor coal fumes, with their pollutant sulfur residues.

Heat-Pump Applications of Special Interest

Among the various applications of the "heat pump" system, we consider to be of special interest those for sterilization of food (sterilization of milk in particular), for recovery of cooling water in electromechanical industry, and for heating and air-conditioning of large offices.

A. Milk-Sterilization Plant

In milk plants, a normal boiler supplies the heat for sterilization; the sterilizing apparatus and the hot milk are cooled by water which is then ejected through a discharge.

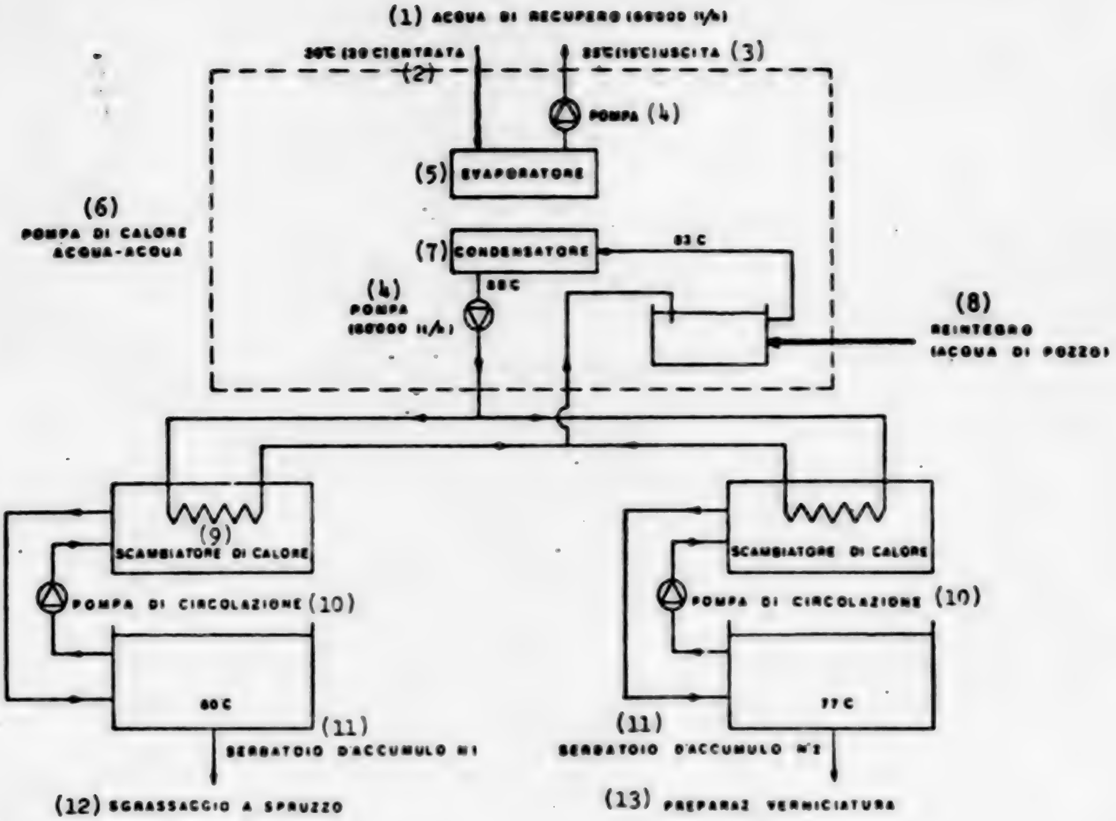


Figure 6. Recovery of heat from a continuous welding line

Key:

1. Recovery water (60,000 liters per hour)
2. Entrance
3. Exit
4. Pump
5. Evaporator
6. Water-water heat pump
7. Condenser
8. Replenishment (well water)
9. Heat exchanger
10. Circulation pump
11. Storage tank
12. Spray scouring
13. Painting preparation

By means of a heat-pump installation (Figure 5), the water can be recovered and sent to the two-pump evaporators and thus be recycled.

The evaporators and the condensers of the two pumps are placed in series so as to increase the system's COP by fractionization of the thermal jumps.

In the condensers, the process water can therefore reach temperatures of 70° to 75° C, and is therefore suitable for four uses:

--preheating of the milk before it is sent to the sterilizer;

--preheating of the water supplied to the boiler;

--space heating (when necessary);

--washing of the machinery and the tanks.

At its exit from the sterilizer, the process water is still at a temperature of about 50° C. Thence it passes into the evaporators, where it is cooled to about 26° C, while in the condensers it is raised again (by electrical energy) to the use temperatures (70° - 75° C).

In this case, the thermal power is about 900 kW (800,000kcal/hour), while the total electrical power absorbed is about 160 kW_e. Therefore the coefficient of performance (COP) is really considerable (higher than 5).

B. Recovery in an Electromechanical Work Process

A second example of application of heat pumps in an industry is the system for recovery of the cooling water for the machinery of an automatic continuour electric welding line (Figure 6). The recovery plant is installed in a firm that manufactures large electrical transformers; a large quantity of cooling water (about 60,000 liters per hour), with temperatures on the order of 30° C, is discharged from the welding line.

Therefore, about 350 kW_t, equal to about 300,000 kcal/hour, are available. By means of the heat-pump system, the temperature level in the condenser reaches 88° C, and the water--by means of the circulation pumps--is stored in tanks and then used in the spray-scouring operations (at about 60° C) and in the painting preparation (at about 77° C).

As is shown by the operating diagram, the system can function even when the welding line is out of service; in such case, the water is taken from the system at about 20° C.

The average COP, in this case, is about 3.3.

C. Heating and Air-Conditioning in Large Office Buildings

The heat-pump systems are especially suitable for large heating and air-conditioning plants, particularly in the case of modern office towers. In fact, in these large building complexes, with their generally square plans and considerably long sides, there are internal zones and spaces that need cooling all year round, because these areas have no contact with the outside, and effectively do not feel variations in climate; their thermal conditions are

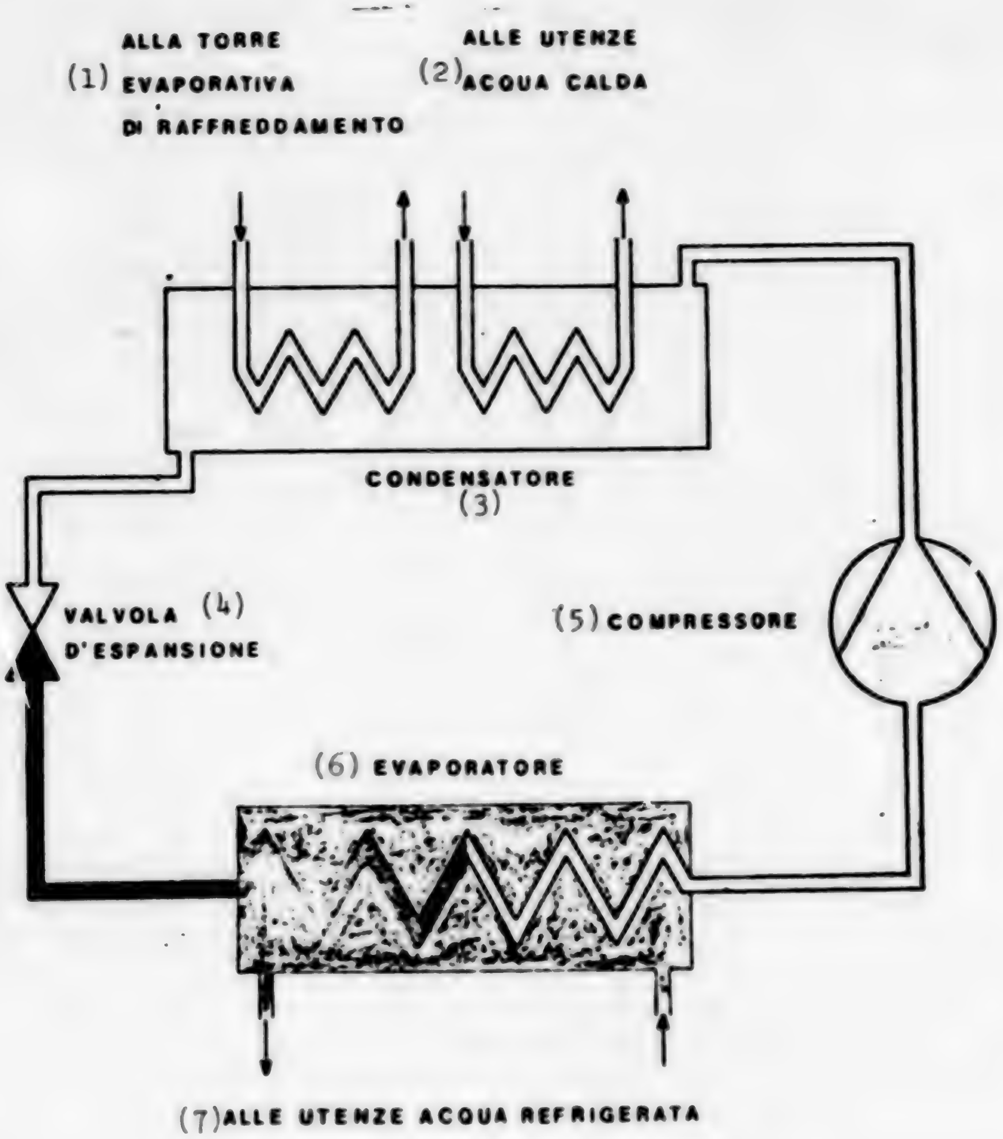

(1) ALLA TORRE EVAPORATIVA DI RAFFREDDAMENTO
(2) ALLE UTENZE ACQUA CALDA
CONDENSATORE (3)
VALVOLA (4) D'ESPANSIONE
(5) COMPRESSORE
(6) EVAPORATORE
(7) ALLE UTENZE ACQUA REFRIGERATA

Figure 7. Heat pump with double condenser

Key:

1. To the evaporating tower for cooling	4. Expansion valve
2. To the hot-water uses	5. Compressor
	6. Evaporator
3. Condenser	7. To the cooled-water uses

---

influenced only by the loads produced by the lighting, the presence of persons, the operation of machinery, etc.

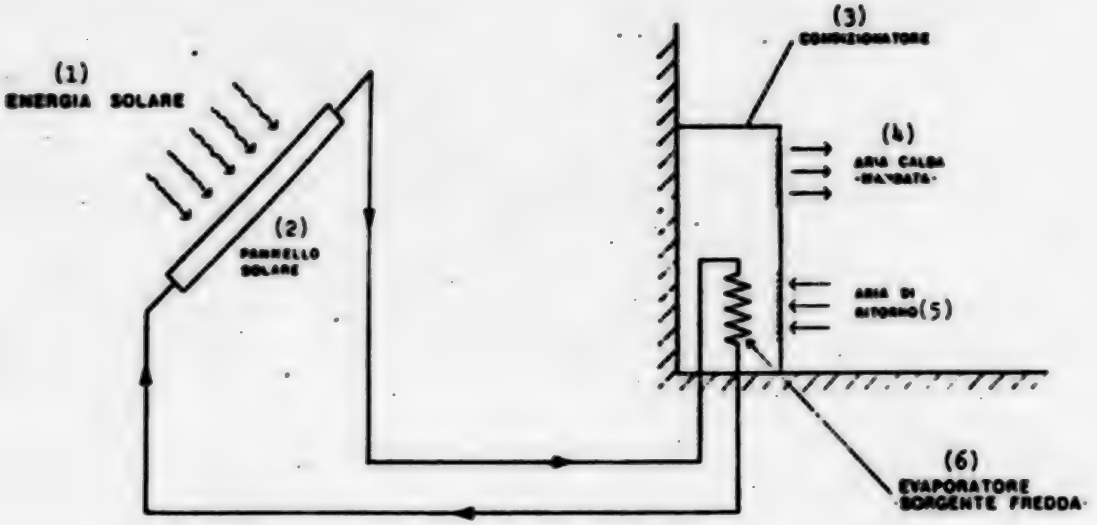


Figure 8. Solar-assisted heat-pump air-conditioner

Key:

1. Solar energy
2. Solar panel
3. Air-conditioner
4. Hot air sent out
5. Return air
6. Cold-source evaporator

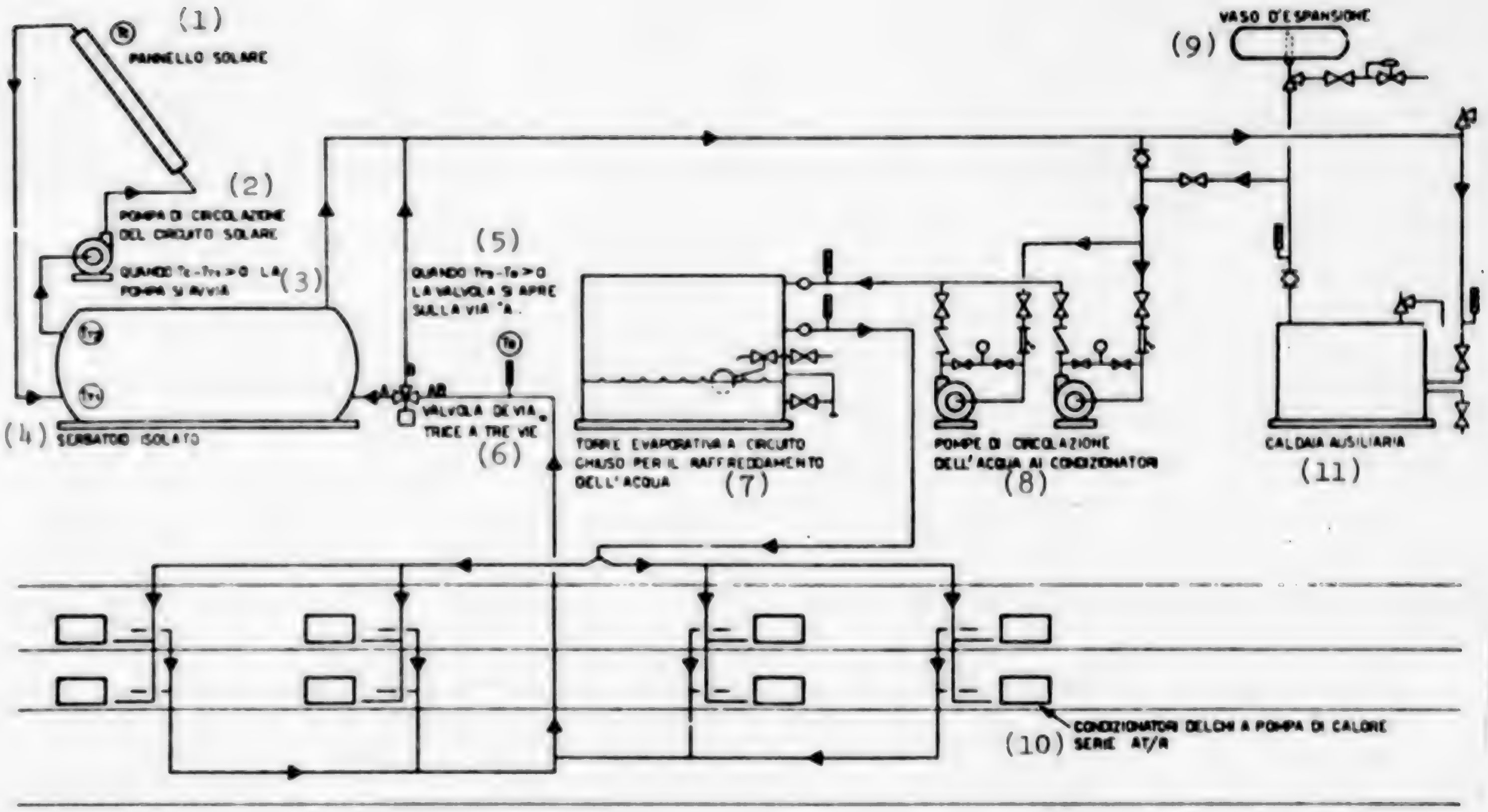
The heat is removed from the internal areas of the building by means of a cooling circuit; the cooling water then gives up its heat in the evaporator and goes into the heat-pump cycle (Figure 7).

In the condenser are two sections (or two condensers). The first section supplies hot water for services year-round and--when necessary and in winter--is used in the space-heating plant; and the second section functions in high summer (when the heat produced would be excessive) and shunts the heat to an outside evaporation tower.

A plant of this kind completely replaces the traditional plant with petroleum-fuel boiler.

Solar-Energy Heat Pumps

The technological meeting between solar energy captured by collectors and the heat pump was easy to foresee, since both systems function with fluids at relatively low temperatures.


(1)
PANNELLO SOLARE
(2)
POMPA DI CIRCOLAZIONE DEL CIRCUITO SOLARE
QUANDO Tc-Tτ1>0 LA POMPA SI AVVIA
(3)
(4) SERBATOIO ISOLATO
(5)
QUANDO Tτ2-TR>0 LA VALVOLA SI APRE SULLA VIA "A"
A
B
AB
VALVOLA DEVIATRICE A TRE VIE
(6)
TORRE EVAPORATIVA A CIRCUITO CHIUSO PER IL RAFFREDDAMENTO DELL'ACQUA
(7)
POMPE DI CIRCOLAZIONE DELL'ACQUA AI CONDIZIONATORI
(8)
VASO D'ESPANSIONE
(9)
CONDIZIONATORI DELCHI A POMPA DI CALORE SERIE AT/R
(10)
CALDAIA AUSILIARIA
(11)

T_c = water temperature at exit from solar panel
T_n = water temperature at base of storage tank
$T_{\tau 2}$ = water temperature at top of storage tank
T_R = Temperature of water returning from air-conditioners supply circuit

Figure 9. Air-conditioning using heat pump and solar panel

Key:

1. Solar panel
2. Circulation pump of solar circuit
3. When $T_c - T_{\tau 1} > 0$, the pump starts
4. Insulated tank
5. When $T_{\tau 2} - T_R > 0$, valve opens into channel "A"
6. Three-way diverting valve
7. Closed-circuit evaporation tower for cooling of water
8. Air-conditioner water circulation pumps
9. Expansion tank
10. DELCHI heat-pump air-conditioners, series AT/R
11. Auxiliary boiler

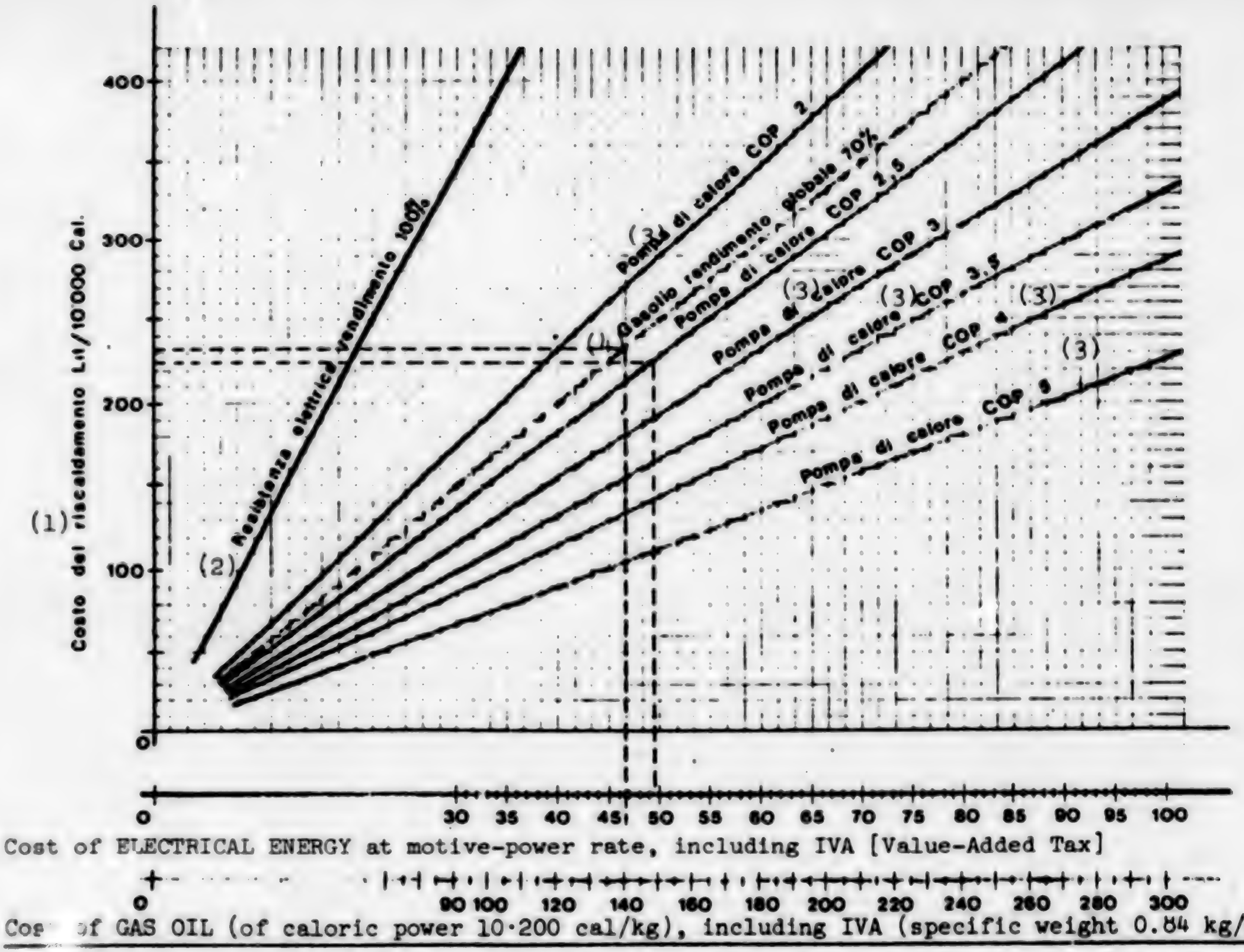


Figure 10. Cost diagram: heat pump--heating with gas oil, electrical heating

Key

1. Cost of heating: lire per 10,000 cal	3. Heat pump
2. Electrical resistance, output 100%	4. Gas oil, overall output 70%

In fact, water at temperatures on the order of 20° to 40° C represents an excellent cold source for the efficiency of a heat pump; and solar collectors, for such low temperatures, have very high efficiencies and can function even in winter in cold zones.

An example is given by by a water-air heat pump (Figure 8), which by means of air-conditioner closets can produce warm air even in wintertime.

Another example is given by the large closed-circuit room air-conditioning installation, functioning with recovery and solar-assisted (Figure 9).

Concluding Observations

A heat-pump installation is usually always suitable when:

--a source of heat (at low temperature) is available that practically costs nothing inasmuch as it consists of fluids (water, air, hot fumes) normally discharged or scattered;

--it is possible to use hot water (at a temperature sharply higher than that of the cold source) for uses that require heat no higher than 100° C.

In designing heat-pump systems, it is necessary to keep it in mind that:

--the smaller the temperature jump (between cold source and hot cource) that the heat pump must make, the less is the investment cost for the installation and the greater is the heat pump's efficiency (COP); and also, the lower is the operating cost;

--use for at least 4,000 hours per year makes the energy saving considerable and permits a higher rate of amortization of the costs.

Finally, the economic advisability of heat-pump systems (even with the variation of costs of electrical energy and petroleum fuels from country to country) is obvious from the final graph (Figure 10), which gives the cost (in lire) for production of 10,000 kcal/hour (equal to 11.6 kW) with the variation in the cost of electrical energy or of combustible fuel (gas oil), and in function of the coefficient of performance (COP) of the heat pump.

We recall that the advantage of use of the heat pump lies precisely in its absorption of little electrical energy to achieve a sizeable increase in the temperature level of the working fluid.

The graph shows clearly that a heat-pump type of thermal installation is more advisable than a gas-oil installation--which has an overall output of 70 percent, and assuming the cost of gas oil at 140 lire per liter--as soon as the pump's COP reaches 2.5 (with the heat pump powered by electrical energy at of cost of 49 lire per kW_t).

BIBLIOGRAPHY

1. "The Templifier for Process Heat," Westinghouse Electric Co., Staunton, VA, U.S.A.

2. Mattalon "Sistemi Avanzati a Recupero di Calore" [Advanced Heat-Recovery Systems], Westinghouse Electric SA, Brussels, Belgium.

3. Farina, D., Engineer, and Redaelli, P.I.G. "Le Pompe di Calore Oggi" [Heat Pumps Today], DELCHI SpA, Villasanta (Milano).

11267
CSO: 3102

NATURE, PURPOSES OF NEW SWEDISH SATELLITE PROJECT

Satellites for Earth Measurement

Stockholm SVENSKA DAGBLADET in Swedish 7 Nov 79 p 19

[Text] One of the biggest satellite projects Sweden has been involved in will begin this week when 24 measurement stations all over Europe start following five special satellites. The intention is to set atomic clocks and to measure the surface of the earth with extreme accuracy.

The satellite system consists of five satellites in orbits crossing the North and South Poles. The satellites were sent up by the U.S. Navy for use as a navigation system for naval ships--but the Americans have seen no reason to prevent anyone else from making use of the system.

The result is that the satellites are now used for navigating private ships--and for scientific purposes. Another use will have great importance for Sweden, namely measurement in the archipelago area--there will no longer be such great uncertainty as to where a ground really is if its position has been determined with the help of the satellite system.

The Swedish project leader for this measurement is Arne Bjerhammar, professor of geodesy at the Technical College.

"One of the advantages of the system is that we now have such small and convenient instruments," he said.

"Instead of big and expensive special antennae and hard to move electronic systems we now have everything in small packages that can be moved anywhere."

The antenna is contained in a box the size of a small suitcase and the electroonic system is no bigger than a TV set.

The principle of the system is quite simple. The satellites send out signals--tones--while they whiz around through space. The measurement stations detect the signals and compare them with taped signals known as reference signals.

If the satellite moves in the direction of the measurement station its signals will be a little higher in tone than the reference signal. If it moves away the tone will be a little lower.

There is a small computer in reception stations that quickly figures the position on the surface of the earth with the help of these tones in connection with information on the orbit of the satellite.

"A very high degree of accuracy can be achieved in this way," said Professor Bjerhammar. "In a short period of time one can determine a position with an accuracy of a few dozen meters."

By measuring longer periods of time and taking into account the alteration of radio signals when passing through the atmosphere, etc. one can become even more accurate--this means down to decimeters. An accuracy within a few meters is really sufficient for most purposes.

The satellites are up there all the time--why do we need a coordinated measurement by 24 stations all over Europe?

"In this way it is easier to take into account a number of sources of error," said Professor Bjerhammar. "What we will actually get will be the position of these 24 measurement stations in relation to each other--and an extremely accurate statement of their relative longitude and latitude on the earth's surface. The system is also used to transmit time from atomic clocks at the various institutions."

Making better maps is one of the obvious uses of the system. On land very accurate measurements can be made using other methods--which require much time and patience--but this is harder in ocean areas.

That is why the Shipping Board has acquired equipment that, it is hoped, will make accidents like the grounding of the Soviet ship "Tsesis" avoidable. With the satellite system islands and shoals can be indicated with an accuracy within a few meters--much better than the accuracy of previous methods.

"The system is important in scientific areas such as continental shift," said Professor Bjerhammar. "This can't be measured directly--but by making repeated measurements between different points at intervals of several years one should be able to see the actual movement."

The present system will be replaced in a few years by a more advanced satellite system called Nova. Nova will have satellites that allow even more accurate measurements--positions with an accuracy within centimeters--and it will also have more satellites, making it possible to get results more quickly.

Anomaly in Magnetic Field

Stockholm SVENSKA DAGBLADET in Swedish 7 Nov 79 p 19

[Article by Hans Rehnvall]

[Text] Precise observations by satellites have shown that there is a "dent" in the earth's gravitational field centered in northern Sweden--a perfect reflection of the depression of the earth's crust that occurred in the Ice Age.

By studying in minute detail how a satellite's orbit is changed one can get a picture of the gravitational field of the earth which contains a number of irregularities of various kinds--"dents."

One way of describing the gravitational field is the so-called geoid. The geoid is a model of the earth that assumes the form of the earth's surface as it would be if it were entirely covered by water. One can imagine tunnels through the continents showing where the ocean surface would be at each location.

At the Geodesic Institute of the Technical College those changes in the gravitational field that could have something to do with the inland ice over Scandinavia have been studied. Scandinavia is actually located on a "hill" in the geoid but it has now been shown that there is a "depression" in the "hill" with its center in northern Sweden--just where the land elevation is greatest!

The map shows this declivity taken from many measurements of satellite orbits.

"The declivity here means that the crust of the earth at this point is subject to a vertical force--a force working to raise the earth," said Professor Bjerhammar. "That detail has some practical interest--it has been discussed in connection with the creation of a final storage area for highly radioactive waste from nuclear power plants.

"If the land elevation resulted from horizontal forces it would be more likely to develop cracks in the bedrock and other sudden changes. The vertical force is not as likely to lead to cracks."

6578
CSO: 3102

SWEDEN DEVELOPS UNMANNED SUBMERSIBLE VEHICLE

Stockholm SVERIGES FLOTTA in Swedish No 11, Nov 79 pp 11-13

[Article by unknown author: "Saab-Sub a Fantastic Diving Technology"]

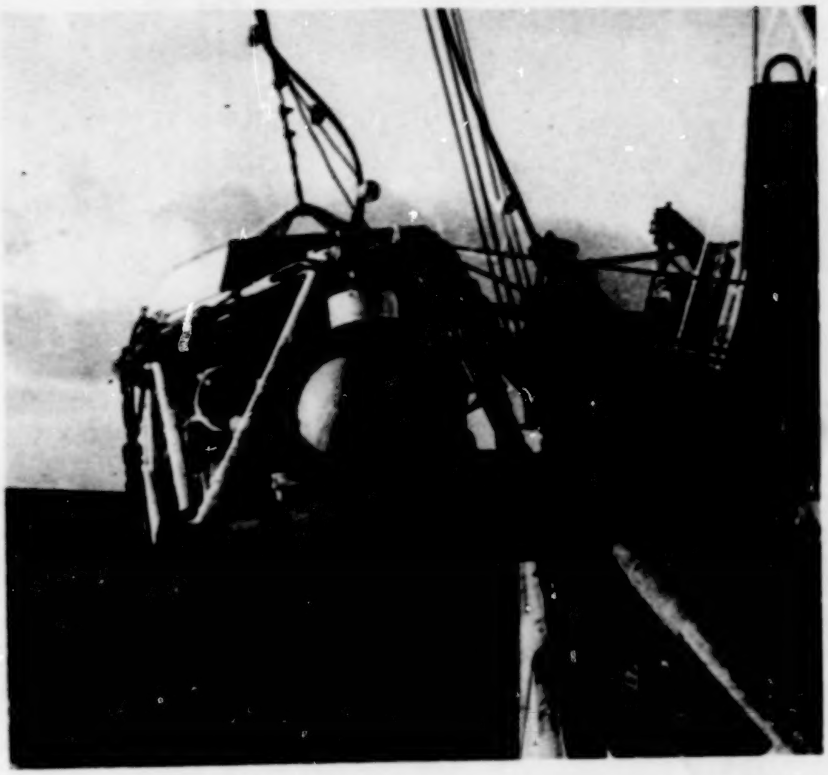
[Text] Exploitation of the resources of the sea and ocean floor -- oil/gas, minerals, foodstuffs -- has increased greatly in the last few years. The clear tendency is that offshore activity will take on greater scope and relative importance in the foreseeable future as well, at the same time as a slow shift toward greater depths and more difficult climactic areas is constantly under way. Needs therefore arise for replacing and supplementing human activities by advanced technological aids.

A few years ago the Saab-Scania Aircraft Division decided to try to enter the area of civilian marine technology, in particular the offshore market, while utilizing the company's existing technology and avialable resources.

Having studied various production alternatives for 1 year, the choice was made to concentrate on an advanced, remotely controlled, unmanned underwater vehicle, Saab-Sub, in principle a replacement for divers.

Saab-Sub is an unmanned remotely controlled vehicle system intended to be able to carry out advanced tasks down to a water depth of 700 meters. The system consists of a submersible vehicle equipped with manipulators, an operator unit with a cable connecting these units and a control center for supplying power.

The Saab-Sub can be regarded as a remotely controlled "manned" vehicle, the crew of which is placed at the "operating console" above the surface. Thus, no environmental or safety-limiting factors exist for the personnel. The feeling of being on board the Saab-Sub is achieved through, among other things, optical presentation and the work manipulator system, in which the arm and hand movements of the operator are copied via the master arm (signal transmission) to the slave arm of the vehicle, and not least through the feeling of having complete control over the vehicle due to its special guidance and stabilization characteristics. All of this takes place during calm conditions on the mother ship (or on land).



Launching of "Saab-Sub" in the search for a shipwrecked vessel (May 1977).

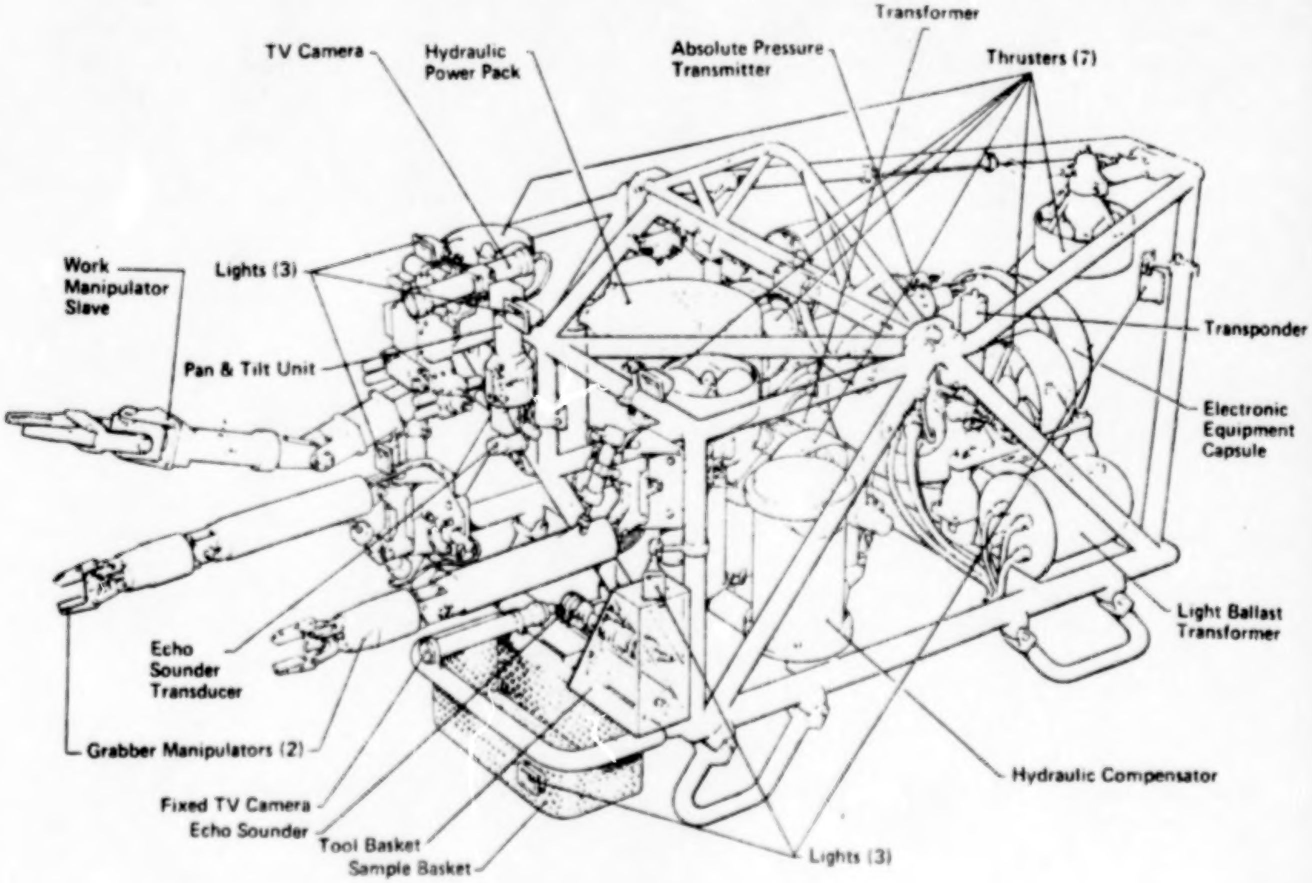
This implies that preconditions have been created for carrying out advanced tasks at great depths under unfavorable conditions to a greater extent than what was previously possible. Saab-Sub is built to work in bad weather as well. The seaworthiness of the mother ship in the only limit on the operations. In March 1977 the Saab-Sub prototype was launched for the first time and an extensive testing period began, including commercial jobs in the North Sea. At the end of 1978 so many experiences had been gathered from the testing that a modification program could be initiated and in August 1979 the Saab-Sub was equipped to again tackle the demanding tasks in the oil and gas fields of the North Sea.

Saab-Sub also fulfills a need outside the special offshore applications. Authorities have obtained the possibility of carrying out or imposing tasks such as environmental supervision, shipwreck investigations, rescue and salvage activity, research and so on, which were previously greatly limited. Even within the defense system great advantages are seen in having access to a Saab-Sub system. For this reason the opportunities are presently being studied of acquiring a Saab-Sub system for joint use by civilian and (naval) military authorities.

Technical Refinements

It is not possible to describe in a brief article all the technical refinements with which the Saab-Sub is equipped, but it is possible to get some idea from the sketch below.

One primary condition for the ability of Saab-Sub to be able to fulfill its tasks is that the vehicle system -- after launching -- can be navigated and maneuvered to the desired spot on the sea floor or to a geographically defined location on the surface of the sea. The spot may (but does not need to) be marked by a hydroacoustical "lighthouse" which the vehicle seeks out. The vehicle must also be maneuvered to a desired movement along a chosen path. Guidance ability, dirigibility and "attitude" stability are thus demands which must be set. This is accomplished with no fewer than 7 hydraulically driven propellers (thrusters) which allow propulsion against normally occurring currents and required attitude control (of the course, rolling, "pitching" and so on). The supply of power is accomplished through an 800 meter long maneuvering cable (umbilical cord) to a hydraulic pump, which in turn transfers power to the propellers. Manual or automatic control of the depth or height above the sea floor and its movements including course guidance take place with the aid of a number of sensors, among others an echo sounder and hydroacoustical position indication, gyroscope and accelerometer as well as television.



Installation Activity on the Sea Floor:

Preliminary study of floor conditions. Assistance in construction (layout).

Periodic inspection, for example non-destructive testing with documentation and assistance in maintenance.

Examples of installations: electrical cables, pipelines, lighthouses anchored on the sea floor, bridge piers, flood gates (Saab-Sub transported over land), oil extraction, equipment for monitoring territorial seas and inlets, mining.

Hydrographic Studies:

For example placement and periodic readings/observation of measuring apparatus and testing equipment.

Geological Study:

Charting of sea floor profiles.

Charting of nearest underlying layers.

Measurement of sediment strength. Fetching of sediment plugs and other samples.

Ecological Study:

Placement and periodic reading/observation of apparatus and test equipment.

Sea Farming:

Working and "harvesting" tools in connection with establishing and tending cultivations at depths greater than about 40 meters.

Rescue/Salvaging Activity:

Assistance in rescuing personnel trapped under water.

Recovery of drowned people in connection with sea and aircraft accidents.

Salvaging of smaller objects.

Assistance in recovering larger objects.

Investigation of Wrecks:

Rapid location and investigation with documentation of shipwrecked vessels. (Older wrecks as well are still interesting, for example the Hansa.)

END OF FICHE

DATE FILMED

24 Jan 80

D.D.